

MASSACHUSETTS COASTAL BASIN  
WAREHAM, MASSACHUSETTS

## TIHONET POND NO. 2 DAM

MA 00030

# PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM



The original hardcopy version of this report  
contains color photographs and/or drawings.  
For additional information on this report  
please email

U.S. Army Corps of Engineers  
New England District  
Email: [Library@nae02.usace.army.mil](mailto:Library@nae02.usace.army.mil)

DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
WALTHAM, MASS. 02154

JULY 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MA 00030	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Tihonet Pond No.2 Dam		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE July 1981
		13. NUMBER OF PAGES 70
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Massachusetts Coastal Basin Wareham, Massachusetts		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Tihonet Pond No.2 Dam consists of an earth embankment with a vertical stone masonry wall over a portion of the downstream face. The embankment has a minimum top width of approximately 30 feet, a maximum height of 15 feet. Based on visual inspection and a review of all available data, the dam is considered to be in poor condition. The dam is classified as "Intermediate" in size, with a "High" hazard potential. A test flood equal to the PMF was selected.		

TC 557

inc

MA 30

C-2

TIHONET POND NO. 2 DAM

MA 00030

MASSACHUSETTS COASTAL BASIN

WAREHAM, MASSACHUSETTS

PHASE 1 INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE 1 INSPECTION REPORT

IDENTIFICATION NO.: MA 00030  
NAME OF DAM : TIHONET POND NO.2 DAM  
TOWN : WAREHAM  
COUNTY AND STATE : PLYMOUTH, MASSACHUSETTS  
STREAM : WANKINCO RIVER  
DATE OF INSPECTION: DECEMBER 9, 1980

BRIEF ASSESSMENT

The Tihonet Pond No. 2 Dam consists of an earth embankment with a vertical stone masonry wall over a portion of the downstream face. The embankment has a minimum top width of approximately 30 feet, a maximum height of 15 feet, and upstream and downstream slopes that vary from vertical at a downstream cut-stone masonry wall to approximately 2 H to 1 V. The overall length of the dam is approximately 660 ft. Included in this length are two spillway structures located at the left and right ends of the dam. These structures consist of stoplogs in concrete slots emptying into conduits that pass through the dam.

The dam impounds Tihonet Pond, which is used for irrigation



and recreational purposes. Water from this pond is used in the irrigation of cranberry bogs downstream. The maximum storage capacity of the dam is about 1250 acre-feet.

Based on visual inspection and a review of all available pertinent data, the dam is considered to be in poor condition. Features that could effect the structural integrity of the dam include wet areas at the downstream toe of the dam, erosion and slumping of dam slopes, extensive tree growth on the dam slopes, movement of the downstream vertical masonry wall.

Based on the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the dam is classified as "Intermediate" in size, with a "High" hazard potential. A Test Flood equal to the Probable Maximum Flood (PMF) was selected in accordance with the Corps of Engineers' Guidelines. The calculated test flood outflow from the pond was about 5500 cfs. The test flood would overtop this dam by about 0.5 ft., it would also overtop a second dam located on this pond, Tihonet Pond No. 1 Dam, by about 2.5 ft. The crest of this second dam is approximately elevation 40 NGVD. The spillway for this dam would carry about 10% of the Test Flood.

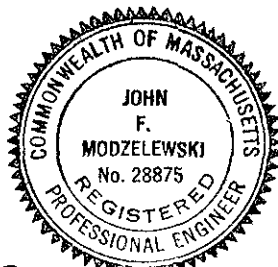
Recommendations include that the owner engage the services of a qualified registered engineer to specify and oversee the removal of trees and root systems on the embankment, investigate the cause of wet areas at the toe of the dam embankment, design and oversee construction of erosion protection for the upstream face and crest of the dam, investigate the stability of the bulged area at the downstream masonry wall.

A detailed hydrologic-hydraulic investigation to assess further the potential of overtopping the dam and the need for and the means to increase project discharge capacity should be performed.

Technical inspections by a qualified, registered engineer should be performed every year. A formal downstream warning system should be put into effect. A formal written maintenance program should be prepared and implemented.

The owner should implement the recommendations and remedial measures as described herein and in greater detail in Section 7 of this Report within 1 year after receipt of this Phase 1 Inspection Report.

ASEC CORPORATION



*John F. Modzelewski*

John F. Modzelewski P.E.

Project Engineer/

Director of Engineering Services

This Phase I Inspection Report on Tihonet Pond No. 2 Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase 1 Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase 1 Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase 1 investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect

to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase 1 inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase 1 Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGES</u>
LETTER OF TRANSMITTAL	i
BRIEF ASSESSMENT	ii - iv
REVIEW BOARD PAGE	v
PREFACE	vi - vii
TABLE OF CONTENTS	viii - x
OVERVIEW PHOTO	xi
LOCATION PLAN	xii

## INDEX TO REPORT

<u>DESCRIPTION</u>	<u>PAGES</u>
1. <u>PROJECT INFORMATION</u>	1 - 10
1.1 GENERAL	
a. AUTHORITY	1
b. PURPOSE OF INSPECTION	1
1.2 DESCRIPTION OF PROJECT	2 - 5
a. LOCATION	2
b. DESCRIPTION OF DAM AND APPURTENANCES	2
c. SIZE CLASSIFICATION	3
d. HAZARD CLASSIFICATION	4
f. OWNERSHIP	4
f. OPERATOR	4
g. PURPOSE OF DAM	4
h. DESIGN AND CONSTRUCTION HISTORY	5
i. NORMAL OPERATIONAL PROCEDURE	5
1.3 PERTINENT DATA	6 - 10
2. <u>ENGINEERING DATA</u>	11 - 12
2.1 DESIGN DATA	11
2.2 CONSTRUCTION DATA	11
2.3 OPERATION DATA	11
2.4 EVALUATION OF DATA	11

DESCRIPTION	PAGES
3. <u>VISUAL INSPECTION</u>	13-18
3.1 FINDINGS	13
a. GENERAL	13
b. DAM	13
c. APPURTENANT STRUCTURES	15
d. RESERVOIR AREA	16
e. DOWNSTREAM CHANNEL	16
3.2 EVALUATION	17
4. <u>OPERATIONAL AND MAINTENANCE PROCEDURES</u>	19-20
4.1 OPERATIONAL PROCEDURES	19
a. GENERAL	19
b. DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT	19
4.2 MAINTENANCE PROCEDURES	19
a. GENERAL	19
b. OPERATING FACILITIES	20
4.3 EVALUATION	20
5. <u>EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES</u>	21-24
5.1 GENERAL	21
5.2 DESIGN DATA	21
5.3 EXPERIENCE DATA	21
5.4 TEST FLOOD ANALYSIS	21
5.5 DAM FAILURE ANALYSIS	22
6. <u>EVALUATION OF STRUCTURAL STABILITY</u>	25
6.1 VISUAL OBSERVATION	25
6.2 DESIGN AND CONSTRUCTION DATA	25
6.3 POST-CONSTRUCTION CHANGES	25
6.4 SEISMIC STABILITY	25

DESCRIPTION	PAGES
7. <u>ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES</u>	26-28
7.1 DAM ASSESSMENT	26
a. CONDITION	26
b. ADEQUACY OF INFORMATION	26
c. URGENCY	27
7.2 RECOMMENDATIONS	27
7.3 REMEDIAL MEASURES	28
a. OPERATING AND MAINTENANCE PROCEDURES	28
7.4 ALTERNATIVES	28

APPENDIXES

APPENDIX	DESCRIPTION	PAGES
A	INSPECTION CHECKLIST	A1 - A9
B	ENGINEERING DATA	B1 - B3
C	PHOTOGRAPHS	C1 - C5
D	HYDROLOGIC AND HYDRAULIC COMPUTATIONS	D1 - D26
E	INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS	E1





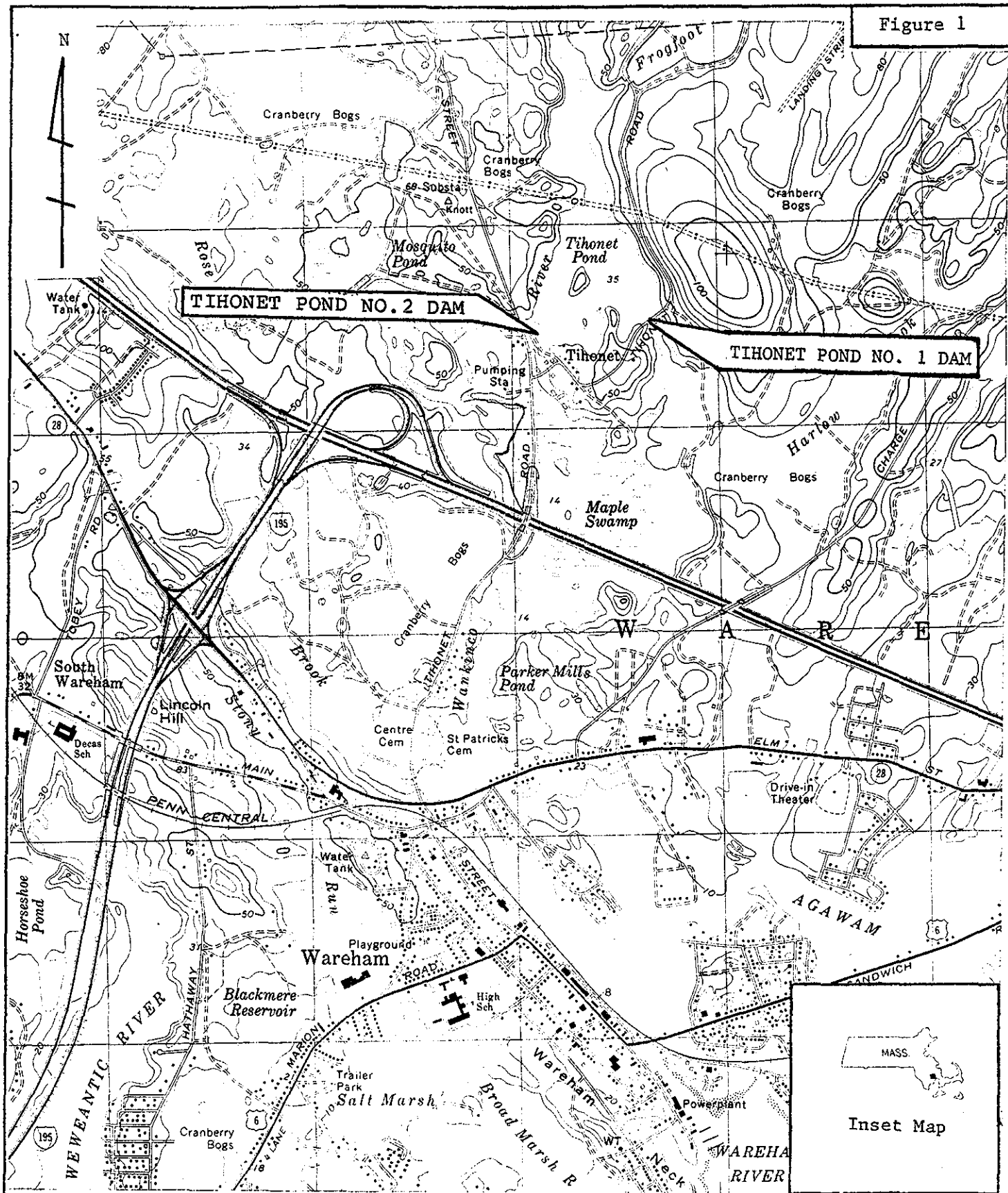
OVERVIEW PHOTO

U.S. ARMY ENGINEER DIV. NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS  
ASEC CORP.  
CONSULTING ENGINEERS  
BOSTON, MASSACHUSETTS

NATIONAL PROGRAM  
OF INSPECTION OF  
NON-FED. DAMS

TIHONET POND NO. 2 DAM  
TR. TO WANKINCO RIVER  
WAREHAM, MASS.  
MA 00030  
DECEMBER 10, 1980

Figure 1



LOCATION PLAN

TIHONET POND NO. 2 DAM  
WAREHAM, MASSACHUSETTS

SCALE: 1 : 25 000

ASEC CORPORATION

WAREHAM QUADRANGLE 1972

# NATIONAL DAM INSPECTION PROGRAM

## PHASE I INSPECTION REPORT

### PROJECT INFORMATION

#### SECTION 1

##### 1.1 GENERAL

###### a. AUTHORITY

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. ASEC Corporation has been retained by the New England Division to inspect and report on selected dams in the state of Massachusetts. Authorization and notice to proceed were issued to ASEC Corporation under a letter of December 8, 1980, from William E. Hodgson, Colonel, Corps of Engineers. Contract No. DACW33-81-C-0023 has been assigned by the Corps of Engineers for this work.

###### b. PURPOSE OF INSPECTION

The purposes of the program are to:

- I. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interests.

II. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.

III. To update, verify and complete the National Inventory of Dams.

## 1.2 DESCRIPTION OF PROJECT

### a. LOCATION

The dam is located on the Wankinco River between Farm to Market Road and Tihonet Road in Wareham, Massachusetts about 2 miles upstream from its confluence with the Agawam River. The dam is shown on the Wareham Quadrangle Map having coordinates latitude  $41^{\circ}-47.3'$  and longitude  $70^{\circ}-43.2'$  (See Figure 1). The dam impounds Tihonet Pond. A second dam located approximately 1800 feet northeast of this dam serves to impound the water of Tihonet Pond also. This dam is referred to as Dam # 14 on Plymouth County Inspection Reports and also as Tihonet Pond No. 1 Dam.

### b. DESCRIPTION OF DAM AND APPURTENANT STRUCTURES

The dam consists of an earth embankment with a vertical stone masonry wall over a portion of the downstream face. The embankment has a minimum top width of approximately 30 feet, a maximum height of 15 feet, and upstream and downstream slopes that vary from vertical at a downstream cut stone masonry wall to approximately 2 H to 1 V. The overall length of the dam is approximately 660 feet including two spillways: a concrete sluiceway controlled by stoplogs with a total weir length of 8.8 ft. emptying into a low level twin 4.2 ft. x 3.6 ft. concrete box

culvert located near the right side of the dam and a second concrete sluiceway controlled by stoplogs with a total weir length of 8.4 ft. emptying into a 5 ft. diameter pipe outlet near the left side of the dam. In addition to these structures a plugged outlet is located approximately 100 ft. to the right of the 5 ft. pipe outlet. A feature which appears to have been an old channel is located about 100 ft. to the left of the pipe outlet. Further data on the dam is contained in Section 1.3. A sketch plan of the dam is located in Appendix B page B-1.

Approximately 1800 ft. northeast of this dam a second dam is located. This dam is referred to as Dam # 14 on Plymouth County Inspection Reports and is also listed as "Tihonet Pond No. 1 Dam - I.D. # MA 00029" on the National Inventory of Dams. The dam is an earthen embankment about 15 ft. high, about 80 ft. wide, and has a crest length of about 400 ft. The crest of the dam is at elevation 40 ± NGVD. Discharge from this site is through 3 - 30 inch culverts and 2 - 24 inch culverts. Outflow from the 3 - 30 inch culverts is controlled by a stoplog structure at the downstream end of the culverts. The stoplogs can be controlled to deliver water to a fishladder or directly to a channel below the culverts. The 2 - 24 inch culverts are controlled by stoplogs in concrete slots at the upstream end of the pipes. These pipes outlet to an earth channel downstream of the site. This dam is shown in Photo # 10 and Photo # 11 of Appendix C.

c. SIZE CLASSIFICATION - "Intermediate"

According to the Corps of Engineers' Recommended Guidelines

for Safety Inspection of Dams, a dam is classified as "Intermediate" in size if the height is between 40 and 100 feet, or the dam impounds between 1000 and 50,000 acre-feet. The dam has a maximum height of 15 ft. and a maximum storage capacity of about 1250 acre-feet. Therefore the dam is classified as intermediate in size based on storage capacity.

d. HAZARD CLASSIFICATION - "High"

Based on the Corps of Engineers' Recommended Guidelines for the Safety Inspection of Dams, the Hazard Classification for the dam is "High". The dam is classified as a "High" Hazard Potential structure because the assumed failure of the dam may result in the loss of more than a few lives and excessive economic losses. Post failure flooding will range 5 - 13 ft. higher than pre-failure flooding, and seriously damage about 8 buildings including 3 mill buildings adjacent to the dam and 2 roads. See Appendix D for assumed failure analysis.

e. OWNERSHIP

Former Owner : Tremont Nail Company  
Present Owner : A.D. Makepeace Company  
Box 151 - 266 Main Street  
Wareham, MA 02571  
(617) 295-1000

f. OPERATOR Mr. Christopher Makepeace  
A.D. Makepeace Company  
Box 151 - 266 Main Street  
Wareham, MA 02571  
(617) 295-1000

g. PURPOSE OF DAM

The dam impounds Tihonet Pond which is a storage reservoir



used principally for irrigating cranberry bogs which are also owned and operated by the A.D. Makepeace Co. In addition a rod and gun club has leased fishing rights from the owner, consequently the reservoir is used for fishing and other water related activities.

#### h. DESIGN AND CONSTRUCTION HISTORY

Design plans for the original dam are not known to exist. The original construction date of the dam is unknown. The dam was probably built in the eighteenth century and certainly no later than the early nineteenth century since the original purpose was to provide water power to an iron rolling mill which existed up to the end of the nineteenth century. From 1880 to 1939 the control and finally ownership of the reservoir and dam was transferred to the present owner.

According to an inspection report by the Massachusetts Department of Public Works dated 8/2/73 the left side concrete sluiceway was replaced in approximately 1954-55. In approximately 1979 some repair work was done to the downstream masonry wall. This work apparently consisted of mortaring portions of the wall. "As-built" sketches made by the Plymouth County Engineering Dept. in 1936 and updated to 1967 depict what is probably the original design concept for the dam. The sketches are part of the Plymouth County Commissioners Dam Inspection records and are included in Appendix B.

#### i. NORMAL OPERATIONAL PROCEDURES

The outlet stoplogs are adjusted by the owner's personnel to

control the flow of water into the bogs downstream of the dam. Occasionally the water level is lowered by removal of stoplogs to control trash fish or for maintenance/repair to the structures.

### 1.3 PERTINENT DATA

#### a. DRAINAGE AREA

The drainage area above the dam is 8.1 square miles. The watershed is characterized by irregular topography: cranberry bogs, small ponds and depressions, and several small streams. Elevations in the watershed range from El. 35  $\pm$  to El. 120  $\pm$  NGVD.

#### b. DISCHARGE AT DAMSITE

The discharge at the dam is controlled by two spillways. The left spillway is a concrete sluiceway controlled by stoplogs with a width of 12 ft. and a height of 11.2 ft. This sluiceway empties into a 5 foot diameter cast iron pipe. The right spillway is a concrete sluiceway controlled by stoplogs with a width of 12 ft. and a height of approximately 12.5 ft. This sluiceway empties into twin box culverts approximately 4.2 ft. wide by 3.6 ft. high.

NGVD = National Geodetic Vertical Datum

1. Outlet Works (conduit) Size:       None
2. Maximum Known Flood at Damsite:   Unknown
3. Ungated Spillway Capacity
- 3a. Right spillway: (without Stoplogs)  
    at Top of Dam                       500 cfs  
    Elevation:                         42.0 ft. NGVD



- |  |                |
|--|----------------|
| Right spillway: (with Stoplogs)*       |                |
| at Top of Dam                          | 250 cfs        |
| Elevation:                             | 42.0 ft. NGVD  |
| 3b. Left spillway: (without Stoplogs)  |                |
| at Top of Dam:                         | 250 cfs        |
| Elevation:                             | 42.0 ft. NGVD  |
| Left spillway: (with Stoplogs)*        |                |
| at Top of Dam:                         | 250 cfs        |
| Elevation:                             | 42.0 ft. NGVD  |
| 4. Ungated Spillway Capacity           |                |
| 4a. Right spillway: (without Stoplogs) |                |
| at Test Flood Elevation                | 550 cfs        |
| Elevation:                             | 42.5 ft. NGVD  |
| Right spillway: (with Stoplogs)*       |                |
| at Test Flood Elevation                | 250 cfs        |
| Elevation:                             | 42.5 ft. NGVD  |
| 4b. Left spillway: (without Stoplogs)  |                |
| at Test Flood Elevation:               | 250 cfs        |
| Elevation:                             | 42.5 ft. NGVD  |
| Left spillway: (with Stoplogs)*        |                |
| at Test Flood Elevation:               | 250 cfs        |
| Elevation:                             | 42.5 ft. NGVD  |
| 5. Gated Spillway Capacity             |                |
| at Normal Pool Elevation               | Not applicable |
| Elevation:                             |                |
| 6. Gated Spillway Capacity             |                |
| at Test Flood Elevation                | Not applicable |
| Elevation:                             |                |
| 7. Total Spillway Capacity*            |                |
| at Test Flood Elevation                | 500 cfs        |
| Elevation:                             | 42.5 ft. NGVD  |
| 8. Total Project Discharge*            |                |
| at top of Dam:                         | 3900 cfs       |
| Elevation:                             | 42.0 ft.       |
| 9. Total Project Discharge*            |                |
| at Test Flood Elevation:               | 5500 cfs       |
| Elevation:                             | 42.5 ft.       |

\* with Stoplogs at El. 35.9 ± NGVD

c. ELEVATION - Feet above National Geodetic Vertical Datum		
1.	Streambed at toe of dam	27.4
2.	Bottom of Cutoff	N/A
3.	Maximum Tailwater	N/A
4.	Normal Pool	35.9 Level encountered Dec. 9, 1980
5.	Full Flood Control Pool	N/A
6.	Spillway crest-without Stoplogs	
	Left spillway	33.5
	Right spillway	30.0
7.	Design Surcharge-Original Design	Unknown
8.	Top of Dam	42.0
9.	Test Flood Surcharge	42.5
d. RESERVOIR - Length in feet		
1.	Normal Pool	5400
2.	Flood Control Pool	N/A
3.	Spillway crest pool (left)	5300 @ El. 33.5
	Spillway crest pool (right)	Unknown @ El. 30.0
4.	Top of Dam	6900
5.	Test Flood Pool	7000
e. STORAGE - Acre-feet		
1.	Normal pool	550
2.	Flood control pool	N/A

3.	Spillway crest pool	300+ @ El. 33.5
	Spillway crest pool	Unknown @ El. 30.0
4.	Top of Dam	1250
5.	Test flood pool	1300
f.	RESERVOIR SURFACE - (Acres)	
1.	Normal Pool	95
2.	Flood Control Pool	N/A
3.	Spillway crest	90+ @ El. 33.5
	Spillway crest	Unknown @ El. 30.0
4.	Test Flood Pool	140
5.	Top of Dam	135
g.	DAM	
1.	Type	Earth embankment
2.	Length	660 feet
3.	Height	15 feet
4.	Top Width	Varies 30 ft. minimum
5.	Side slopes	
	Upstream	Approx. 2 H to 1 V
	Downstream	Varies; vertical to 2 H to 1 V
6.	Zoning	Unknown
7.	Impervious Core	Unknown
8.	Cutoff	Unknown
9.	Grout curtain	Unknown
10.	Other	N/A

h. DIVERSION AND REGULATING TUNNEL N/A

i. SPILLWAYS

RIGHT SPILLWAY:

1. Type	Stoplogs in Concrete slots
2. Length of Weir	8.8 ft; 2 - 4.4 ft bays
3. Crest	Varies from El. 42.0 to 30.0 NGVD
4. Gates	Stoplogs
5. Upstream channel	Not observed
6. Downstream channel	Stone Masonry
7. General	Flows into twin concrete box culverts 4.2 ft. wide x 3.6 ft. high, downstream invert 27.4 ft. NGVD

LEFT SPILLWAY:

1. Type	Stoplogs in Concrete slots
2. Length of Weir	8.4ft; 2 - 4.2 ft bays
3. Crest	Varies from El. 42.0 to 33.5 ft. NGVD
4. Gates	Stoplogs
5. Upstream channel	Not observed
6. Downstream channel	Stone Masonry
7. General	Flows into 5 ft. diameter iron pipe Downstream Invert 32.8 ft. NGVD

j. REGULATING OUTLETS N/A

## ENGINEERING DATA

### SECTION 2

#### 2.1 DESIGN DATA

There was no design data available for review for this dam. Inspection reports of the dam prepared by Plymouth County Commissioners and the Massachusetts Department of Public Works were reviewed. These contain sketches of the dam.

#### 2.2 CONSTRUCTION DATA

No construction data was available for review. The name of the contractor responsible for construction is unknown.

#### 2.3 OPERATIONAL DATA

Records of the reservoir level are not kept. The reservoir level is raised or lowered by the owner's foreman in response to the operational demands of the cranberry bogs downstream.

#### 2.4 EVALUATION OF DATA

##### a. AVAILABILITY

Data reviewed was provided by the Plymouth County Commissioners and by the Massachusetts Department of Public Works. A list of the available reference material and their location is given in Appendix B.

##### b. ADEQUACY

The lack of depth of engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and

construction data, but is based primarily on visual inspection, past performance history, hydraulic and hydrologic calculations and sound engineering judgment.

c. VALIDITY

No design plans were reviewed, however inspection sketches reviewed appear to represent fairly existing conditions at the time of the visual inspection.

## VISUAL INSPECTION

### SECTION 3

#### 3.1 FINDINGS

##### a. GENERAL

The visual inspection of the dam was conducted on December 9, 1980. At the time of inspection the level of the pond was approximately 36 ft. NGVD or approximately 6 feet below the top of the dam. The general condition of the dam at the time of inspection was poor.

##### b. DAM

The dam consists of an earth embankment with a vertical stone masonry wall over a portion of the downstream face.

The crest of the dam consists primarily of medium to fine sand. Little or no vegetation is growing along the roadway which occupies the middle third of the crest. Grass, brush and trees are growing along the upstream and downstream edge of the crest (Photo # 1). The crest to the left of the left outlet structure is covered with grass and large trees. On the left side of the dam, a large overgrown linear depression which appeared to be an old channel was observed which extended from the reservoir edge approximately 90 feet parallel to the edge of the reservoir toward the downstream toe of the dam. The entrance to the channel adjacent to the reservoir is blocked up and covered with trees and brush. No outlet to the channel could be located during the site visit. At the time of inspection, no information was available on the previous uses of the apparent channel.

The upstream slope of the dam consists of embankment soil with no evidence of riprap protection and is covered with brush and trees up to 24 inches in diameter (Photo # 1). The slope is quite irregular and appears to have experienced widespread erosion. Numerous erosion gullies up to 1 ft. deep were evident along the slope and adjacent to the concrete intake and spillway structure (Photos # 2 & # 3).

The downstream slope of the dam to the right of the old plugged outlet consists of embankment soil and is covered with grass, brush and trees up to 20 inches in diameter. A small stone wall, 2.5 ft. high, was observed at several locations on the slope near the downstream toe of the dam. Two large excavations were observed at the toe of the dam near the right end of the dam. The excavations were approximately 15 ft. wide, 4 ft. deep, and the surface was covered with leaves and brush. At the time of the site inspection no information was available on the reason for these excavations. To the southeast of the right spillway, a wet area approximately 15 ft. long was observed just downstream from the toe of the dam with no visible evidence of flow.

In the vicinity of the old plugged outlet, the downstream soil slope has been replaced with a vertical stone masonry wall for the full height of the dam (Photo # 4). Most of the wall is mortared except for a 50 ft. unmortared section near the plugged outlet. The wall has tilted up to 6 inches in the downstream direction (Photo # 5). Portions of the wall appear to have been repointed recently.

Standing water is present near the base of the downstream



wall in the vicinity of the plugged outlet pipe. The water contains numerous orange flocs with no evidence of the movement of fines. The base of the former outlet channel in the vicinity of the downstream wall is covered with brush, grass, and small saplings (Photo # 4).

One animal burrow, 12 inches in diameter and approximately 15 inches deep, was noted on the crest of the dam to the left of the left outlet structure.

#### c. APPURTENANT STRUCTURES

The left spillway is located near the left end of the dam and consists of stoplogs in a concrete intake structure and a 5 ft. diameter iron pipe which empties into a channel of approximately vertical cut stone masonry block training walls (Photos # 6 & # 7). The concrete intake structure is in fair condition. Planking over access panels to the intake is rotted in places. Stoplogs were in fair condition.

The right spillway includes a concrete intake structure controlled by stoplogs which is in good condition (Photo # 1 & # 2). Flow from the intake structure passes into 4.2 ft. wide by 3.6 ft. high concrete culverts which pass through the dam and exits at the downstream toe. The interior of the box culverts were visually examined and are in good condition (Photo # 8). Stoplogs are in fair condition. Some erosion of the embankment has occurred near the downstream toe adjacent to the concrete box culvert and at the upstream intake structure.

The old outlet works is located approximately 100 ft. northwest of the left outlet. Both intake and outlet appear to have been plugged and were not visible during the site visit (Photos # 4 & # 9). The downstream channel bottom near the old outlet works was covered with water containing numerous orange colored flocs with no flow evident.

A 22 inch diameter cast iron pipe was noted next to the 5 ft. diameter pipe (Photo # 7). The purpose of this pipe could not be determined.

A 4 in. cast iron pipe was noted approximately 8 ft. above the base of the masonry wall south of the old plugged outlet. The purpose of this pipe could not be determined.

#### d. RESERVOIR AREA

No evidence of significant sedimentation in the reservoir was observed. No evidence of slope instability was apparent in the immediate vicinity of the dam.

#### e. DOWNSTREAM CHANNEL

The outlet channel for the left outlet is comprised of cut-stone masonry channel with approximately vertical training walls. The training walls are in fair condition with some indication of distortion and missing blocks. The flow falls from the iron pipe to this masonry channel then passes under a small wood plank foot bridge and joins an adjacent channel coming from the plugged outlet works.

The outlet channel for the right outlet consists of

nearly vertical training walls which are comprised of cobbles and boulders. The channel passes through a concrete culvert underneath the adjacent roadway and into the adjacent cranberry bogs.

The channel downstream of the old outlet works consists of cut-stone masonry walls. The downstream training walls are generally in fair condition with some of the cap blocks having fallen into the channel. The channel bottom is covered with logs, brush and trees up to 4 inches in diameter growing on the channel bottom. This channel flows into a box culvert and then joins with the outlet channel of the left outlet.

### 3.2 EVALUATION

On the basis of the visual inspection the dam is judged to be in poor condition.

The wet area at the downstream toe to the right of the plugged outlet works may be evidence that the line of seepage through the dam exits at the toe, a condition which could lead to a piping failure if the embankment or foundation soils are susceptible to piping.

Trees growing on the embankment and next to the downstream toe of the dam could be a cause of seepage and piping problems if a tree falls over and pulls out its roots or if a tree dies or is cut and its roots rot.

Lack of vegetation over a large portion of the crest of the dam makes the crest susceptible to erosion if the dam should

be overtopped.

An animal burrow on the crest of the dam could lead to seepage and piping problems if not properly plugged.

The lack of riprap on the upstream slope in the normal range of reservoir levels has contributed to extensive slumping and erosion of the upstream slope. Continued erosion could lead to instability and possible breaching of the dam.

Tilt and displacement of the downstream stone masonry wall near the spillway outlet works could lead to collapse of the wall if allowed to continue.

The purpose of the 22 inch and 4 inch pipes at the dam is unknown, therefore the affect of these items on the dam's long term stability cannot be assessed.

The excavations at the downstream slope reduce the dam cross section and increase erosion of the slope.

## OPERATIONAL AND MAINTENANCE PROCEDURES

### SECTION 4

#### 4.1 OPERATIONAL PROCEDURES

##### a. GENERAL

The dam is used primarily for irrigation and recreational purposes. The water impounded by the dam is used to irrigate cranberry bogs downstream of the dam. A local rod and gun club has leased fishing rights from the owner of Tihonet Pond and uses this pond for water related recreational activity.

The dam is operated in conjunction with another dam, Tihonet Pond No. 1 Dam to the east of this site. The outlets of both dams are regulated by personnel from A.D. Makepeace Co. to control the flow of water into the bogs as required for growing.

Occasionally the water level is lowered by removing stoplogs to control trash fish and for maintenance or repair to the structures.

##### b. DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no formal warning system in effect.

#### 4.2 MAINTENANCE PROCEDURES

##### a. GENERAL

The dam is visited on a continuous basis, by the owners' operating personnel who has responsibility for all dams in his assigned area.

#### b. OPERATING FACILITIES

The stoplogs at the left and right spillways are the operational portions of this dam requiring maintenance. These items are observed on a daily basis.

#### 4.3 EVALUATION

Present operational procedures should be modified to include a formal warning system: The dam is monitored during periods of heavy rainfall presently, however, a formal procedure for notifying downstream authorities in the event of an emergency should be prepared.

Maintenance procedures for the dam should be modified to include inspection and maintenance of the dam embankment as well as the spillways. A written set of maintenance procedures should be prepared and implemented. These procedures should include monthly inspections, periodic removal of brush from the dam slopes and crest and correction of any minor erosion noted during inspections.

A technical inspection of the dam should be performed once a year by a qualified registered engineer.

## EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

### SECTION 5

#### 5.1 GENERAL

Tihonet Pond No. 2 Dam is located in a rural area of Wareham, Massachusetts. The reservoir surface is about 95 acres at normal level and has a drainage area of 8.1 square miles.

A second dam is located on Tihonet Pond, Tihonet Pond No. 1 Dam, approximately 1800 ft. to the east of Tihonet Pond No. 2 Dam. These dams are operated in conjunction with one another. For the purposes of this study the outlets from Tihonet Pond No. 1 Dam were considered closed. Weir flow over Tihonet Pond No. 1 Dam was considered in the Test Flood analysis.

#### 5.2 DESIGN DATA

No design data was available for this report.

#### 5.3 EXPERIENCE DATA

No data is available on past flood experiences.

#### 5.4 TEST FLOOD ANALYSIS

Based on the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the size of the dam is intermediate. The dam has approximately 1250 acre-ft of storage. Based on dam failure analysis and the above Guidelines the dam is classified as "High" hazard potential.

Based on the Corps of Engineers' guidelines the Test Flood

should be the Probable Maximum Flood (PMF). Use of the Corps of Engineers guide curves for "flat & coastal" terrain results in a peak inflow of about 6000 cfs or about 750 cfs/sq. mi. The inflow was then routed through the reservoir using the Corps of Engineers' "Surcharge Routing Alternative" and resulted in an attenuated peak test flood of 5500 cfs. For the routing calculations the reservoir was assumed to be at normal pool elevation, the elevation encountered during the visual inspection, and the pond was expanded in area during the rise. The test flood was found to rise to a pond elevation of 42.5 ft. NGVD, which is 0.5 ft. above the dam embankment (El. 42.0 ft. NGVD). The spillways pass about 10% of the Test Flood.

#### 5.5 DAM FAILURE ANALYSIS

A dam failure analysis was made using the "Rule of Thumb Guidance" provided by the Corps of Engineers. Failure was assumed with the water level at the top of the dam (El. 42.0 ft. NGVD) and assumed breach size was 192 feet. Spillways were not included in the breach. Pre-failure flow was about 500 cfs as compared with post-failure flow of about 19,000 cfs. Based on this analysis and Corps of Engineers' guidelines, the dam is classified as having a "High" hazard potential: a breach of the dam may damage about 8 buildings and potentially cause the loss of more than a few lives. The prime impact area is located near the dam where 3 mill buildings will receive over 7 ft. of flooding and Farm to Market Road will be overtopped by the flood wave.



If the mill buildings are inhabited at the time of failure loss of life may occur. On the north outlet one house will receive major flooding with possible loss of life.

Further downstream damage will consist of flooding to 3 commercial/industrial buildings, 1 pump station, and 1 road. Post-failure flooding at the commercial/industrial structure will be one to five feet compared to no flooding prior to the assumed failure. The pump house will be inundated and the road washed out by five feet of flooding. If any of these structures or roadway are inhabited at the time of flooding loss of life may occur. The flood wave will then become attenuated by Maple Swamp.

Table 1 summarizes the results of the assumed dam failure. The dam breach calculations and a map of the approximate downstream impact area are shown in Appendix D.

Location no. (see map)	Distance D/S of Dam (ft)	Number of Structures	Level Above Stream (ft)	Flow (CFS) Stage (Ft. above Stream)		Comments
				Before Failure	After Failure	
1	105 - 422	3 mill buildings	4-12	234/1.5	18,988/19.3	Major damage to mill buildings. Significant dan- ger of loss of life.
		road	4-5			Probable wash-out.
		1 house	4-5			Major damage to 1 house. Significant danger of loss of life.
2	422- 615 615	road	5	234/1.4	18,270/14	Probable wash-out.
		pump station	5-6			Major damage to pump sta.
		1 house	15-16			
3	615- 1,675'	3 (probable) commercial/ industrial bldgs.	5-10	234/0.3	17,984/10.2	Some damage to (probable) commercial/industrial buildings. Some danger of loss of life.
4	1,700			234/0.5	15,073/7.8	Flood wave attenuating in Maple Swamp.
	2,629			234/0.5	11,266/6.5	
	2,835	road	15-26			Some erosional damage as flood wave impacts roadway & passes through waterway openings.

Table 1 - Summary of Downstream Flooding

## EVALUATION OF STRUCTURAL STABILITY

### SECTION 6

#### 6.1 VISUAL OBSERVATIONS

The visual observations did not disclose evidences of overall instability, however, the downstream stone masonry wall has tilted locally indicating a potential future instability.

#### 6.2 DESIGN AND CONSTRUCTION DATA

There was no design and construction data available at the time of inspection.

#### 6.3 POST-CONSTRUCTION CHANGES

Field inspection indicates a number of post-construction changes made on this dam. It appears that the left and right outlets are not original, an outlet has been plugged, and an apparent discharge channel has been blocked off. No design drawings were available for these post-construction changes.

There is reference on one of the state inspection reports that the concrete spillway structure on the left side of the dam was replaced in approximately 1954 or 1955. No design drawings were available for the post-construction repair.

#### 6.4 SEISMIC STABILITY

The dam is located in Seismic Zone 2 and in accordance with the Phase 1 inspection guidelines does not warrant seismic stability analysis.

## ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

### SECTION 7

#### 7.1 DAM ASSESSMENT

##### a. CONDITION

Based on the visual inspection, the dam is judged to be in poor condition. The following conditions are indicative of potential long-term problems:

1. A wet area adjacent to the downstream toe of the dam indicates that the line of seepage through the dam exits at or near the toe, a condition which could lead to a piping failure if the embankment or foundation soils are susceptible to piping.

2. Trees growing on the embankment and the downstream toe of the dam could be a cause of seepage and piping problems if one of the trees blows over and pulls out its roots or if a tree dies or is cut and its roots rot.

3. Continued erosion and slumping of the upstream slope of the dam could lead to serious seepage and piping problems.

4. Bulging of the downstream masonry wall to the right of the spillway works could threaten the integrity of the dam.

5. Excavations at the downstream slope of the dam reduce the dam cross-section and increase erosion of the slope.

##### b. ADEQUACY OF INFORMATION

The information available is such that the assessment of this dam must be based primarily on the results of the visual

inspection which is adequate for the purposes of the Phase 1 inspection.

c. URGENCY

The owner should implement the recommendations in 7.2 and 7.3 within one year after the receipt of this report.

7.2 RECOMMENDATIONS

The following recommendations should be carried out under the direction of a qualified, registered engineer.

1. Investigate the cause of the wet area adjacent to the downstream toe near the right spillway and the wet area in the downstream channel at the plugged outlet, design and oversee construction of remedial measures as required.

2. Specify procedures for removing the trees and root systems from the embankment and an area 20 ft. from the toe of the dam; oversee the backfilling operation.

3. Design and oversee construction of erosion protection for the upstream face and crest of the dam.

4. The stability of the bulged area of the downstream masonry wall to the right of the spillway works should be analyzed and stabilization measures should be undertaken as required. Appropriate drainage features should be included in any stabilization measures.

5. Prepare a plan of all pipes (including the 22 " pipe near the left outlet) and other structures within the vicinity of the dam embankment which may provide seepage paths through the dam.

6. Specify procedures for filling erosion gullies and animal burrows, oversee the backfilling operation.

7. Investigate the need for backfilling the excavated areas near the right end of the dam, specify remedial measures as required.

8. Perform a detailed hydrologic-hydraulic investigation to assess further the potential of overtopping the dam and the need for and the means to increase project discharge capacity.

### 7.3 REMEDIAL MEASURES

#### a. OPERATION AND MAINTENANCE PROCEDURES

1. Institute a formal downstream warning system to include monitoring the dam during extremely heavy rains, and procedures for notifying downstream authorities in the event of an emergency.

2. Engage a qualified, registered engineer to make a comprehensive technical inspection of the dam once every year.

3. Remove all brush from the dam embankment.

4. Establish an on-going maintenance program including but not limited to: removal of brush from the dam embankment and discharge channels, correction of minor erosion at dam and repair of animal burrows on dam slopes.

### 7.4 ALTERNATIVES

There are no practical alternatives to the above recommendations.

APPENDIX A

VISUAL CHECKLIST WITH COMMENTS

VISUAL INSPECTION CHECKLIST  
PARTY ORGANIZATION

PROJECT TIHONET POND NO.2 DAM

DATE DECEMBER 9, 1980  
TIME 1:00 P.M.  
WEATHER CLEAR, COLD  
W.S. EL. 35.9 U.S.,  
27.4 D.S.

PARTY:

- |                                    |   |
|------------------------------------|---|
| 1. <u>John F. Modzelewski P.E.</u> | ASEC Corporation - Civil/Structural           |
| 2. <u>Richard M. Baker</u>         | Vollmer Associates Inc. - Hydrologist         |
| 3. <u>Richard F. Murdock P.E.</u>  | Geotechnical Engineers Inc. -<br>Geotechnical |
| 4. <u>Richard W. Turnbull</u>      | Geotechnical Engineers Inc. -<br>Geotechnical |

<u>PROJECT FEATURE</u>	<u>INSPECTED BY</u>
1. Dam Embankment	GEI
2. Dike Embankment	None observed
3. Outlet Works - Intake Channel Intake Structure	ASEC, GEI
4. Outlet Works - Control Tower	None observed
5. Outlet Works - Transition & Conduit	ASEC
6. Outlet Works - Outlet Structure & Outlet Channel	ASEC, GEI
7. Outlet Works - Spillway Weir, Approach & Discharge Channels	ASEC, GEI
8. Outlet Works - Service Bridge	ASEC



# PERIODIC INSPECTION CHECKLIST

PROJECT TIHONET POND NO. 2 DAM DATE Dec. 9, 1980  
 PROJECT FEATURE see below NAME JFM, RFM, RFT  
 DISCIPLINE Civil Engineer, Geotechnical Engineer NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	
Crest Elevation	El. 42.0 ± NGVD
Current Pool Elevation	El. 36.0 ± NGVD
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Pavement Condition	No pavement.
Movement or Settlement of Crest	None observed; minor undulations.
Lateral Movement	None observed.
Vertical Alignment	Sta 4+05 and 4+35; stone wall displaced d/s 3-6"; general d/s bulge in wall from top to about the middle
Horizontal Alignment	Minor-moderate erosion adjacent to and behind former & existing concrete outlet works.
Condition at Abutment and at Concrete Structures	None observed.
Indications of Movement of Structural Items on Slopes	Large pit on crest Sta 6+15 to 6+95; pit begins approx. 15' back from reservoir & is approx 80' long by 25' wide by 5' deep; walls covered w/slag & bottom covered w/(dumped?) vegetative debris; approx. smaller pits on d/s slope at 0+05 to 0+18 & 0+20 to 0+35. Occasional footpaths along N/S reservoir banks.
Trespassing on Slopes	Extensive moderate erosion and sloughing of N/S face; oversteepening & undercutting reservoir banks.
Sloughing or Erosion of Slopes or Abutments	None observed.
Rock Slope Protection - Riprap Failures	Wet area at top of d/s slope Sta 2+75 may indicate seepage. Water leaking from 4" drainage pipe located 6' below top of d/s stone wall at Sta 3+80. Minor seepage thru former outlet conduit.
Unusual Movement or Cracking at or Near Toe	None observed.
Unusual Embankment or Downstream Seepage	None observed.
Piping or Boils	None observed.
Foundation Drainage Features	None observed.
Toe Drains	None observed.
Instrumentation System	None observed.
Vegetation	Crest; generally barren; some pine needles grass, it brush u/s. It to dense brush d/s variable density brush & trees; floor has leaves, pine needles, brambles & humus.

# PERIODIC INSPECTION CHECKLIST

PROJECT TIHONET POND NO. 2 DAM DATE Dec. 9, 1980  
 PROJECT FEATURE see below NAME --  
 DISCIPLINE -- NAME --

AREA EVALUATED	CONDITION
<u>DIKE EMBANKMENT</u> Crest Elevation Current Pool Elevation Maximum Impoundment to Date Surface Cracks Pavement Condition Movement or Settlement of Crest Lateral Movement Vertical Alignment Horizontal Alignment Condition at Abutment and at Concrete Structures Indications of Movement of Structural Items on Slopes Trespassing on Slopes Sloughing or Erosion of Slopes or Abutments Rock Slope Protection - Riprap Failures Unusual Movement or Cracking at or Near Toes Unusual Embankment or Downstream Seepage Piping or Boils Foundation Drainage Features Toe Drains Instrumentation System Vegetation	None.

# PERIODIC INSPECTION CHECKLIST

PROJECT TIHONET POND NO. 2 DAM DATE Dec. 9, 1980  
 PROJECT FEATURE see below NAME JFM, RFM, RWT  
 DISCIPLINE Civil Engineer, Geotechnical Engineer NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>EXISTING</u> <u>OUTLET WORKS - INTAKE CHANNEL AND</u> <u>INTAKE STRUCTURE</u> a. Approach Channel Slope Conditions Bottom Conditions Rock Slides or Falls Log Boom Debris Condition of Concrete Lining Drains or Weep Holes b. Intake Structure - North (Right) Condition of Concrete Flashboards Stop Logs and Slots Intake Structure - South (Left) Condition of Concrete Flashboards and Slots Other	Not observed (under water). None N/A N/A None observed. Good - some erosion of concrete along inside slots, no reinforcing visible Fair - Flashboards Slots in good condition Good Fair - Flashboards Slots in good condition Southern wood access cover partially rotted

1 A

# PERIODIC INSPECTION CHECKLIST

PROJECT TIHONET POND NO. 2DAM DATE Dec. 9, 1980  
 PROJECT FEATURE see below NAME JFM, RFM, RWT  
 DISCIPLINE Civil Engineer, Geotechnical Engineer NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<p><u>FORMER OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u></p> <p>a. Approach Channel</p> <p>Slope Conditions</p> <p>Bottom Conditions</p> <p>Rock Slides or Falls</p> <p>Log Boom</p> <p>Debris</p> <p>Condition of Concrete Lining</p> <p>Drains or Weep Holes</p> <p>b. Intake Structure</p> <p>Condition of Concrete</p> <p>Stop Logs and Slots</p>	<p>Not observed (under water).</p> <p>None observed.</p> <p>Plugged</p>

# PERIODIC INSPECTION CHECKLIST

PROJECT TIHONET POND NO. 2 DAM

DATE Dec. 9, 1980

PROJECT FEATURE see below

NAME --

DISCIPLINE --

NAME --

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - CONTROL TOWER</u>	
a. Concrete and Structural	None
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

# PERIODIC INSPECTION CHECKLIST

PROJECT TIHONET POND NO. 2 DAM DATE Dec. 9, 1980

PROJECT FEATURE see below NAME JFM

DISCIPLINE Civil/Structural Engineer NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - TRANSITION AND CONDUIT</u>	
NORTH OUTLET: (Right)	
General Condition of Concrete	Good
Rust or Staining on Concrete	None observed
Spalling	None observed
Erosion or Cavitation	None observed
Cracking	None observed
Alignment of Monoliths	N/A
Alignment of Joints	None visible
Numbering of Monoliths	N/A
<u>OUTLET WORKS - TRANSITION AND CONDUIT</u>	
SOUTH OUTLET: (Left)	
General Condition of Conduit	Pitted cast iron, fair condition
Transition	Invert broken at downstream end
	Not observed

# PERIODIC INSPECTION CHECKLIST

PROJECT TIHONET POND NO. 2 DAM DATE Dec. 9, 1980  
 PROJECT FEATURE see below NAME JFM  
 DISCIPLINE Civil Engineer NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>EXISTING</u> <u>OUTLET WORKS - OUTLET STRUCTURE AND</u> <u>OUTLET CHANNEL</u>  General Condition of Concrete Rust or Staining Spalling Erosion or Cavitation Visible Reinforcing Any Seepage or Efflorescence Condition at Joints Drain holes  Channel : South Outlet Discharge Channel General Condition Loose Rock or Trees Overhanging Channel Floor of Channel Other obstructions  Channel : North Outlet Discharge Channel General Condition  Loose Rock Overhanging Channel  Trees Overhanging Channel  Floor of Channel  Other Obstructions  Other Comments	 North Outlet: (Right) No outlet Structure; Conduit merely ends  South Outlet: (Left).  No outlet structure; Conduit ends     Good Occasional cobble in stone masonry sidewalls , no trees overhanging channel  Very occasional cobble in concrete channel None

# PERIODIC INSPECTION CHECKLIST

7 A

PROJECT TIHONET POND NO. 2 DAM DATE Dec. 9, 1980  
 PROJECT FEATURE see below NAME JFM, RFM, RWT  
 DISCIPLINE Civil Engineer, Geotechnical Engineer NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>FORMER OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition of Concrete	N/A outlet plugged
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	None observed
Channel	
Loose Rock or Trees Overhanging Channel	Unmortared channel wall base in places; A tree to 4" dia. growing in channel floor.
Condition of Discharge Channel	Left and right walls of channel generally intact; some blocks have fallen into channel; channel partially blocked with pits of logs, brush & stone blocks; channel bottom partially sedimented and ponded and is supporting light brush, grass and weeds.



# PERIODIC INSPECTION CHECKLIST

PROJECT TIHONET POND NO. 2 DAM

DATE Dec. 9, 1980

PROJECT FEATURE see below

NAME JFM, RFM, RWT

DISCIPLINE Civil Engineer, Geotechnical Engineer

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u></p> <p>a. Approach Channel</p> <p>    General Condition</p> <p>    Loose Rock Overhanging Channel</p> <p>    Trees Overhanging Channel</p> <p>    Floor of Approach Channel</p> <p>b. Weir and Training Walls</p> <p>    General Condition of Concrete</p> <p>    Rust or Staining</p> <p>    Spalling</p> <p>    Any Visible Reinforcing</p> <p>    Any Seepage or Efflorescence</p> <p>    Drain Holes</p> <p>c. Discharge Channel</p> <p>    General Condition</p> <p>    Loose Rock Overhanging Channel</p> <p>    Trees Overhanging Channel</p> <p>    Floor of Channel</p> <p>    Other Obstructions</p> <p>    Other Comments</p>	<p>No spillway - see OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</p>

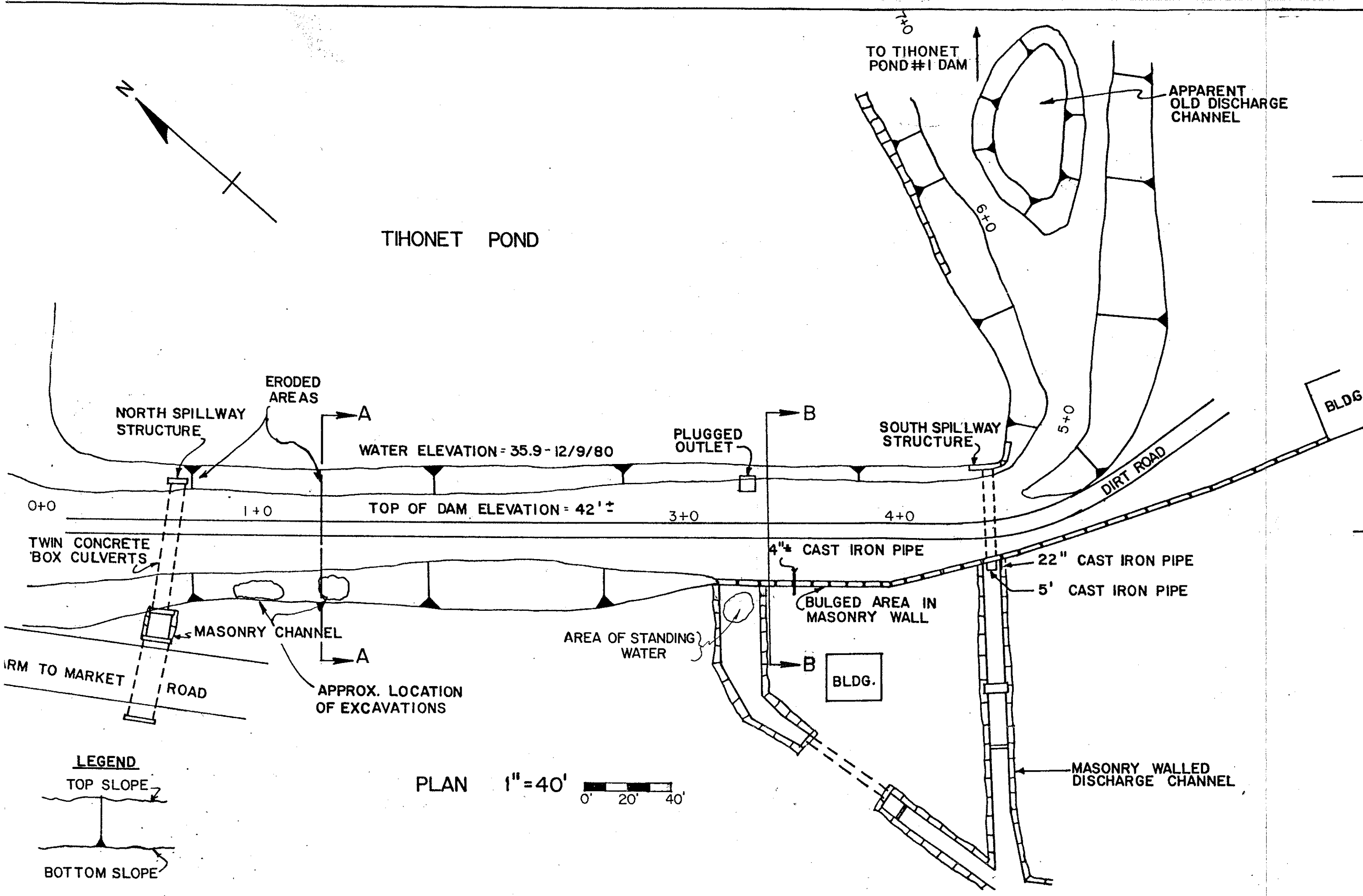
# PERIODIC INSPECTION CHECKLIST

PROJECT TIHONET POND NO. 2 DAM DATE Dec. 9, 1980  
 PROJECT FEATURE see below NAME --  
 DISCIPLINE -- NAME ---

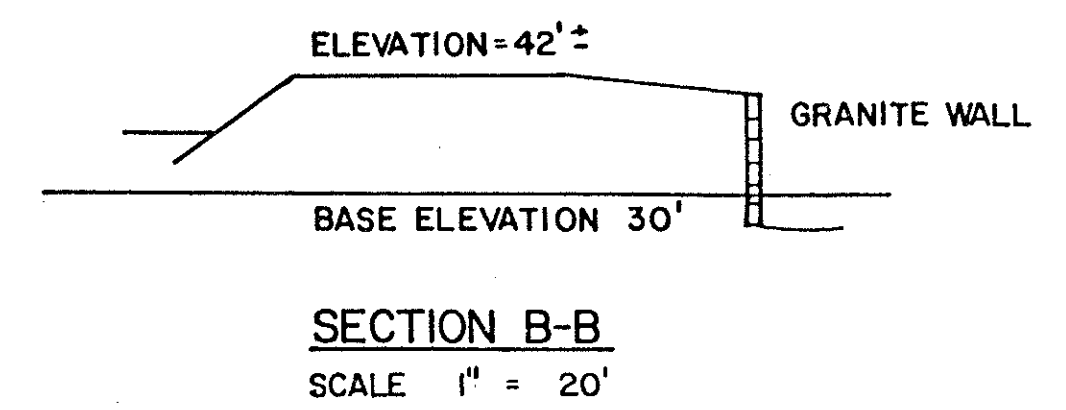
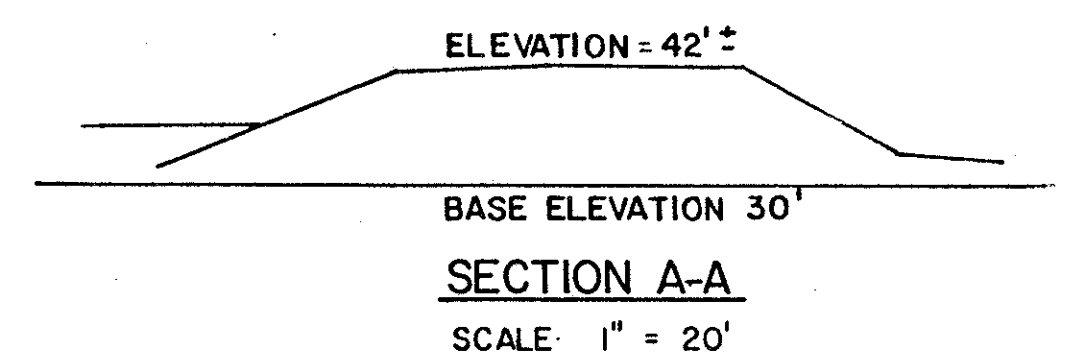
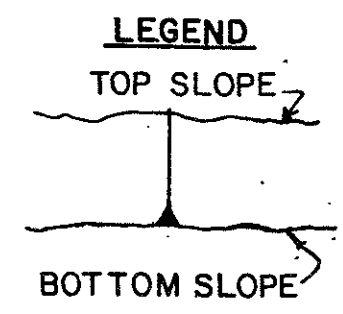
AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE</u> a. Super Structure Bearings Anchor Bolts Bridge Seat Longitudinal Members Underside of Deck Secondary Bracing Deck Drainage System Railings Expansion Joints Paint b. Abutment & Piers General Condition of Concrete Alignment of Abutment Approach to Bridge Condition of Seat & Backwall	None

APPENDIX B  
ENGINEERING DATA

FIG. 2



PLAN 1" = 40'



ASEC CORPORATION CONSULTING ENGINEERS BOSTON , MASS.			U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS 'OF ENGINEERS WALTHAM, MASS.		
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS					
TIHONET POND #2 DAM WAREHAM, MASS. MASS.#00030					
DRAWN	CHECKED	APPROVED	SCALE	DATE	PAGE
J.P.	J.F.M.	J.F.M.	AS SHOWN	12-9-80	B-1

## LIST OF REFERENCES

REFERENCE	LOCATION
1. Inspection Report - Dams & Reservoirs Dam # 7-12-310-7 Dated 10-3-75	Mass. Dept. of Environmental Quality Engineering Division of Waterways 1 - 11 Winter Street Boston, MA 02110 Tel. (617) 727-4797
2. Inspection of Dams & Reservoirs Dam # 15 Dated July, 1936	Plymouth County Commissioners Highway Department South Russel Street Plymouth, MA 02360

# INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: City/Town Wareham Dam No. 7-12-310-7  
 Name of Dam Tibonet Pond #2 Inspected by: K. B. Harrison & E. E. Bumpus  
 Date of Inspection: 10-3-75

2. Owner/s: Per: Assessors ☒ Prev. Inspection 8-2-73  
 Reg. of Deeds \_\_\_\_\_ Pers. Contact \_\_\_\_\_

1. A. D. Makepeace Co. - 266 Main St Wareham, Mass.  
 Name \_\_\_\_\_ St. & No. \_\_\_\_\_ City/Town \_\_\_\_\_ State \_\_\_\_\_ Tel. No. \_\_\_\_\_

Name \_\_\_\_\_ St. & No. \_\_\_\_\_ City/Town \_\_\_\_\_ State \_\_\_\_\_ Tel. No. \_\_\_\_\_

Name \_\_\_\_\_ St. & No. \_\_\_\_\_ City/Town \_\_\_\_\_ State \_\_\_\_\_ Tel. No. \_\_\_\_\_

3. Caretaker: (if any) e.g. superintendent, plant manager appointed by absentee owner, appointed by multi-owners.

Name \_\_\_\_\_ St. & No. \_\_\_\_\_ City/Town \_\_\_\_\_ State \_\_\_\_\_ Tel. No. \_\_\_\_\_

4. No. of Pictures taken: None

5. Degree of Hazard: (if dam should fail completely)\*

1. Minor \_\_\_\_\_ 2. Moderate \_\_\_\_\_

3. Severe ☒ 4. Disastrous \_\_\_\_\_

\*This rating may change as land use changes (future development)

6. Outlet Control: Automatic \_\_\_\_\_ Manual ☒

Operative: Yes ☒ No \_\_\_\_\_

Comments: Two Bay Concrete Flume w/ Plankboards & 6.0" metal outlet pipe

7. Upstream Face of Dam:

Conditions:

1. Good ☒ 2. Minor Repairs \_\_\_\_\_

3. Major Repairs \_\_\_\_\_ 4. Urgent Repairs \_\_\_\_\_

Comments: Numerous trees but dam has good height and extreme width 46' t.

Dam No. 7-12-310-7

## 8. Downstream Face of Dam:

## Conditions:

1. Good ☒ 2. Minor Repairs \_\_\_\_\_  
3. Major Repairs \_\_\_\_\_ 4. Urgent Repairs \_\_\_\_\_

Comments: Same as upstream face.9. Emergency Spillway: Yes

## Conditions:

1. Good ☒ 2. Minor Repairs \_\_\_\_\_  
3. Major Repairs \_\_\_\_\_ 4. Urgent Repairs \_\_\_\_\_

Comments: Two box conc. flume w/ flat boards & twin 4.5' x 4' conc. box culv. outlets.

## 10. Water Level at Time of Inspection:

6.2 ft. \_\_\_\_\_ above ☒ below top of dam.  
☒ principal spillway \_\_\_\_\_ other

## 11. Summary of Deficiencies Noted:

Growth (Trees & Brush) on Embankment Yes  
Animal Burrows & Washouts No  
Damage to Slopes or Top of Dam No  
Cracked or Damaged Masonry No  
Evidence of Seepage No  
Evidence of Piping No  
Erosion No  
Leaks Yes - minor through flat boards  
Trash and/or Debris Impeding Flow No  
Clogged or Blocked Spillway No  
Other \_\_\_\_\_

Dam No. 7-12-310-7

## 12. Remarks &amp; Recommendations (fully explain)

This dam is in good general condition  
except for numerous trees on embankment.  
It is questionable whether trees need cutting  
as dam has extreme height & width  
Minor leakage noted through flashboards.

## 13. Overall Condition:

1. Safe ☒
2. Minor Repairs Needed ☐
3. Conditionally Safe - Major Repairs Needed ☐
4. Unsafe ☐
5. Reservoir Impoundment no Longer Exists (explain)  
Recommend Removal from Inspection List ☐



## INSPECTION REPORT - DAMS AND RESERVOIRS

OE  
FILE 711

1. Location: City/Town WAREHAM Dam No. 7-12-310-7  
Name of Dam TIDNET POND #2 Inspected by: JOHN DELANOS J. MCGARRY  
Date of Inspection 8-2-73

2. Owner/s: Per: Assessors ✓ Prev. Inspection 1-22-71  
Reg. of Deeds \_\_\_\_\_ Pers. Contact \_\_\_\_\_

1. A.D. MAKEPEACE CO. 266 MAIN ST. WAREHAM, MASS.  
Name St. & No. City/Town State Tel. No.

Name St. & No. City/Town State Tel. No.

Name St. & No. City/Town State Tel. No.

3. Caretaker: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name St. & No. City/Town State Tel. No.

4. No. of Pictures taken NONE

5. Degree of Hazard: (if dam should fail completely)\*

1. Minor \_\_\_\_\_ 2. Moderate \_\_\_\_\_

3. Severe ✓ 4. Disastrous \_\_\_\_\_

\*This rating may change as land use changes (future development)

6. Outlet Control: Automatic \_\_\_\_\_ Manual ✓

Operative ✓ yes; \_\_\_\_\_ No

Comments: FLASHBOARDS

7. Upstream Face of Dam: Condition:

Conditions:

1. Good ✓ 2. Minor Repairs \_\_\_\_\_

3. Major Repairs \_\_\_\_\_ 4. Urgent Repairs \_\_\_\_\_

Comments: MANY TREES ON EMBANKMENT, BUT  
DAM WIDTH IS SUFFICIENT SO AS NOT TO WARRANT  
THEIR REMOVAL

8. Downstream Face of Dam:

Dam No. 2-12-310-7

Condition: 1. Good ✓

2. Minor Repairs \_\_\_\_\_

3. Major Repairs \_\_\_\_\_

4. Urgent Repairs \_\_\_\_\_

Comments: SAME AS ITEM #7

9. Emergency Spillway:

Condition: 1. Good ✓

2. Minor Repairs \_\_\_\_\_

3. Major Repairs \_\_\_\_\_

4. Urgent Repairs \_\_\_\_\_

Comments: \_\_\_\_\_

10. Water Level at Time of Inspection:

6 ft. above \_\_\_\_\_ . below ✓ . top of dam \_\_\_\_\_  
principal spillway ✓ . other \_\_\_\_\_ :

11. Summary of Deficiencies Noted:

Growth (Trees & Brush) on Embankment YES

Animal Burrows & Washouts NO

Damage to Slopes or Top of Dam NO

Cracked or Damaged Masonry NO

Evidence of Seepage NO

Evidence of Piping NO

Erosion NO

Leaks NO

Trash and/or Debris Impeding Flow NO

Clogged or Blocked Spillway NO

Other \_\_\_\_\_

12. Remarks & Recommendations: (Fully Explain)

THIS DAM IS IN GOOD GENERAL CONDITION.

13. Overall Condition:

1. Safe ✓
2. Minor Repairs Needed \_\_\_\_\_
3. Conditionally Safe - Major Repairs Needed \_\_\_\_\_
4. Unsafe \_\_\_\_\_
5. Reservoir Impoundment no Longer Exists (explain)  
Recommend Removal from Inspection List \_\_\_\_\_

## DESCRIPTION OF DAM

DISTRICT 17Submitted by JOHN DELANDDam No. 7-12-310-7Date 8-2-73City/Town WAREHAMName of Dam TIDONET POND #21. Location: Topo Sheet No. 45C

Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

2. Year Built \_\_\_\_\_ Year/s of Subsequent Repairs \_\_\_\_\_

3. Purpose of Dam: Water Supply \_\_\_\_\_ Recreational \_\_\_\_\_  
Irrigation ☒ Other \_\_\_\_\_4. Drainage Area: 10 Sq.Mi. \_\_\_\_\_ Acres5. Normal Ponding Area: \_\_\_\_\_ Acres \_\_\_\_\_ Ave. Depth  
Impoundment: 175,000,000 Gals. \_\_\_\_\_ Acre Ft.6. No. and Type of Dwellings Located Adjacent to Pond or Reservoir  
i.e. Summer Homes, etc. 1 HOME7. Dimensions of Dam: Length 1650 FT Max. Height 25 FT  
Slopes: Upstream Face VERT.  
Downstream Face VERT.  
Width Across Top 46 FT

8. Classification of Dam by Material:

Earth ☒ Conc. Masonry \_\_\_\_\_ Stone Mason. \_\_\_\_\_

Timber \_\_\_\_\_ Rockfill \_\_\_\_\_ Other \_\_\_\_\_

DAM NO. 7-12-310-7

9.

A. Description of Present Land Usage Downstream of Dam:

160 % rural                      % urban

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure      ✓      yes      no

10.

## Risk to Life and Property in Event of Complete Failure

No. of People 6

No. of Homes 2

No. of Businesses 0

No. of Industries 1 Type CRANBERRY

No. of Utilities 0 Type                     

Railroads 0

Other Dams 7-12-310-2

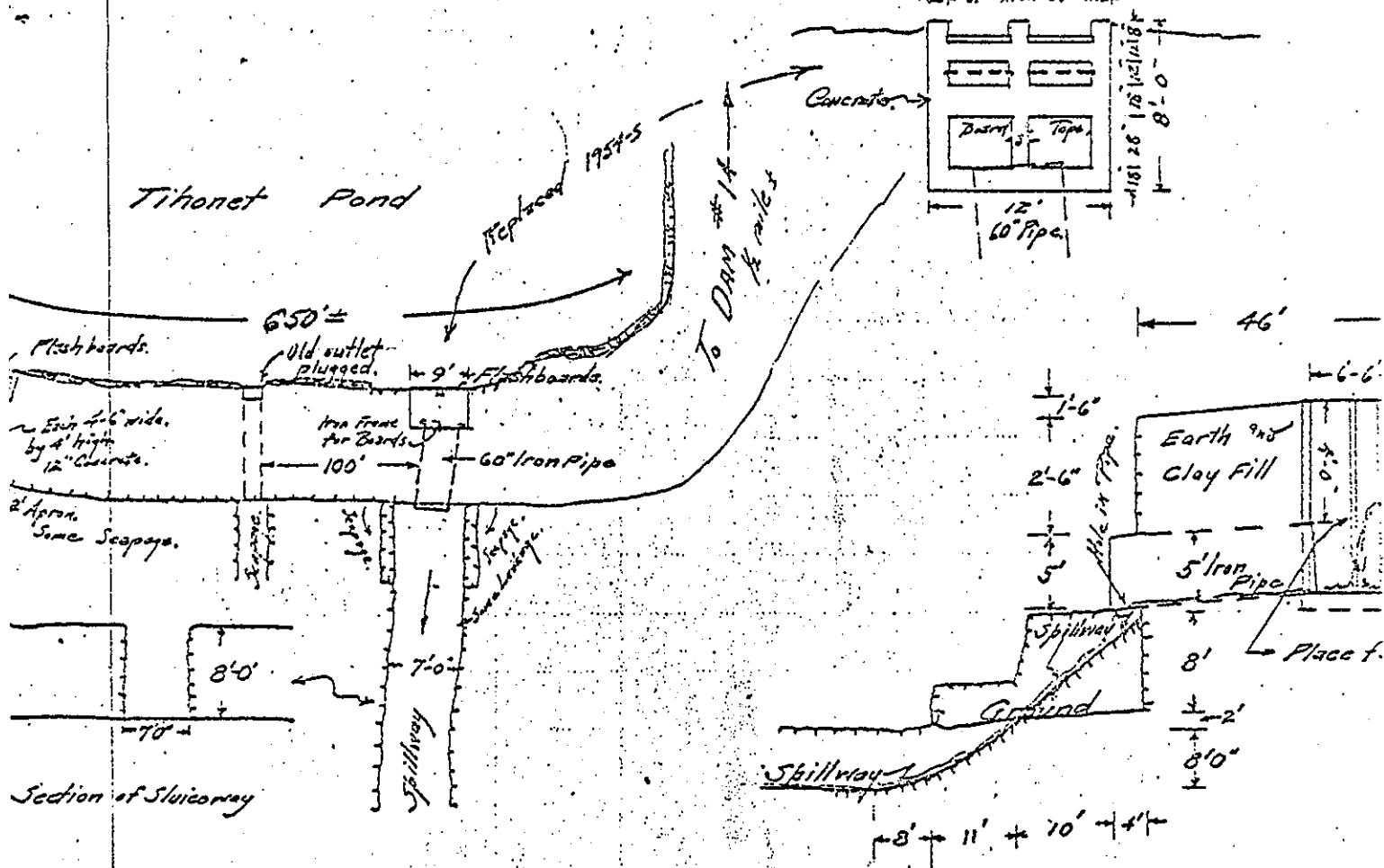
Other RTE 2.5 RTE 2.8

11.

Attach sketch of dam to this form showing section and plan on an 8½" x 11" sheet.

7-12-310-7

Sketch of Dam (not to Scale)



2/10/11

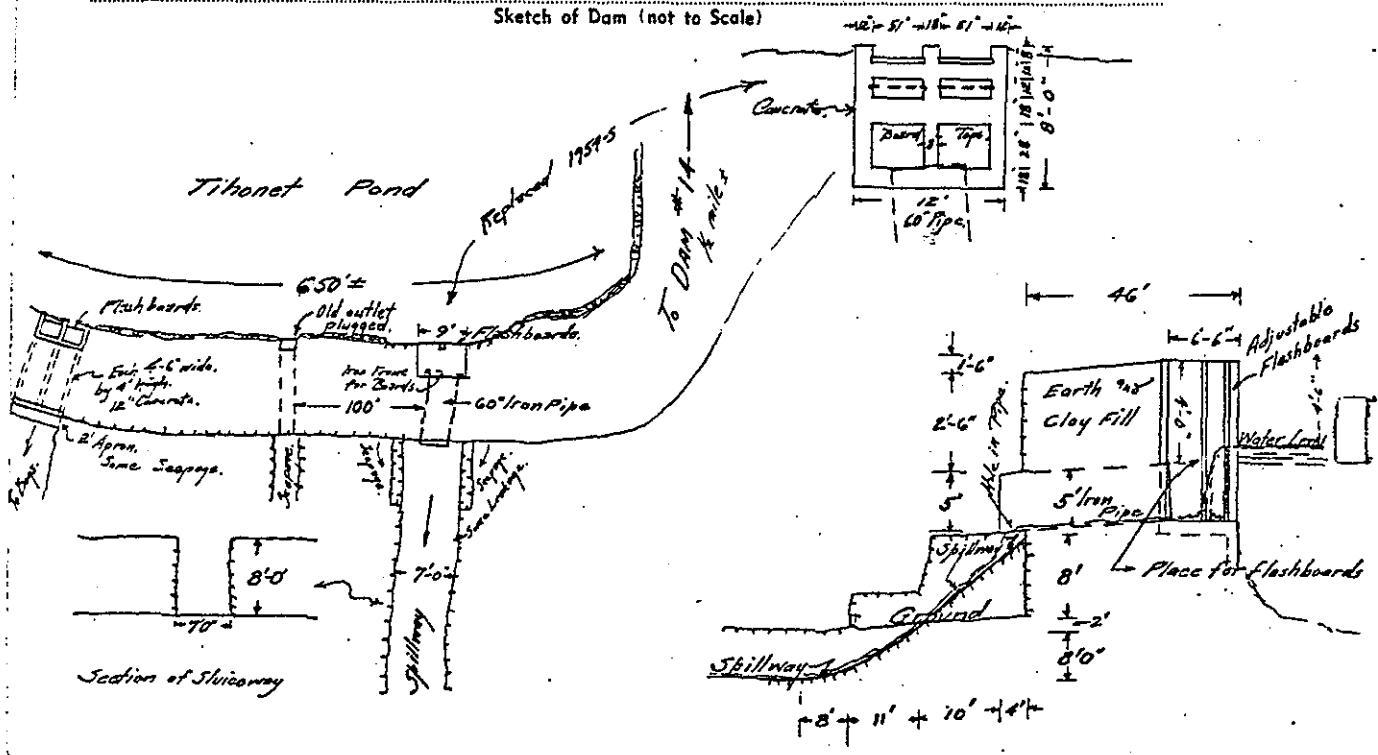
COUNTY OF PLYMOUTH, MASSACHUSETTS  
ENGINEERING DEPARTMENT  
INSPECTION OF DAM AND RESERVOIRS

DAM NO. 15

Inspector Bamber P. Chace Date July, 1936 City or Town Wareham  
Location West side of Tihonet Pond - North Wareham  
Owner A. D. Makepeace Co. Use Reservoir for Bogs  
Material and Type Sand Dyke with Stone Facing  
(Main Dam forming Tihonet Pond.)  
Maximum Head in Feet (Full Pond Level to Bottom of Spillway) 25 feet  
Length 650 feet Width 46 feet  
Area of Watershed 10 Sq. Miles Capacity 175,000,000 Gallons  
Length of Overflow or Spillway \_\_\_\_\_ Outlets (Pipes or Flumes) \_\_\_\_\_  
5' diam. Iron Pipe (See #14)  
Dam Constructed by \_\_\_\_\_ Date \_\_\_\_\_  
Recent Repairs \_\_\_\_\_ Date \_\_\_\_\_  
Evidence of Leakage Slight Leakage near spillway  
Condition Good  
Topography of Country Below Flat - Cranberry Bogs and Parker Mills Pond  
Nature, extent, proximity, etc. of buildings, roads or other property in danger if failure should occur.  
Complete failure (which is unlikely) would cause serious damage to two  
roads, damage a large storage of Cranberry Bogs, shops and storerooms  
of the Makepeace Co. and the Tremont Nail Works Plant at  
Wareham Centre.  
Remarks and Recommendations  
This Dam is in good condition and is well maintained.  
Spillways ample in conjunction with #14 and with proper  
regulation.  
Unchanged June 1938 & Feb. 1939. Unchanged Dec. 1941. Unchanged Apr. 1942.  
Good - unchanged Nov. 1948. No changes Nov. 1949. Good - unchanged Sept. 1951. No changes  
Mar. 1953. Good condition Nov. 1955. Same - no changes June 1957. Good - sound Sept. 1959.  
Sound - good & safe Sept. 1961. Good - no change Dec. 1965. Good - no change  
Nov. 1967. Good - no change Oct. 1969.



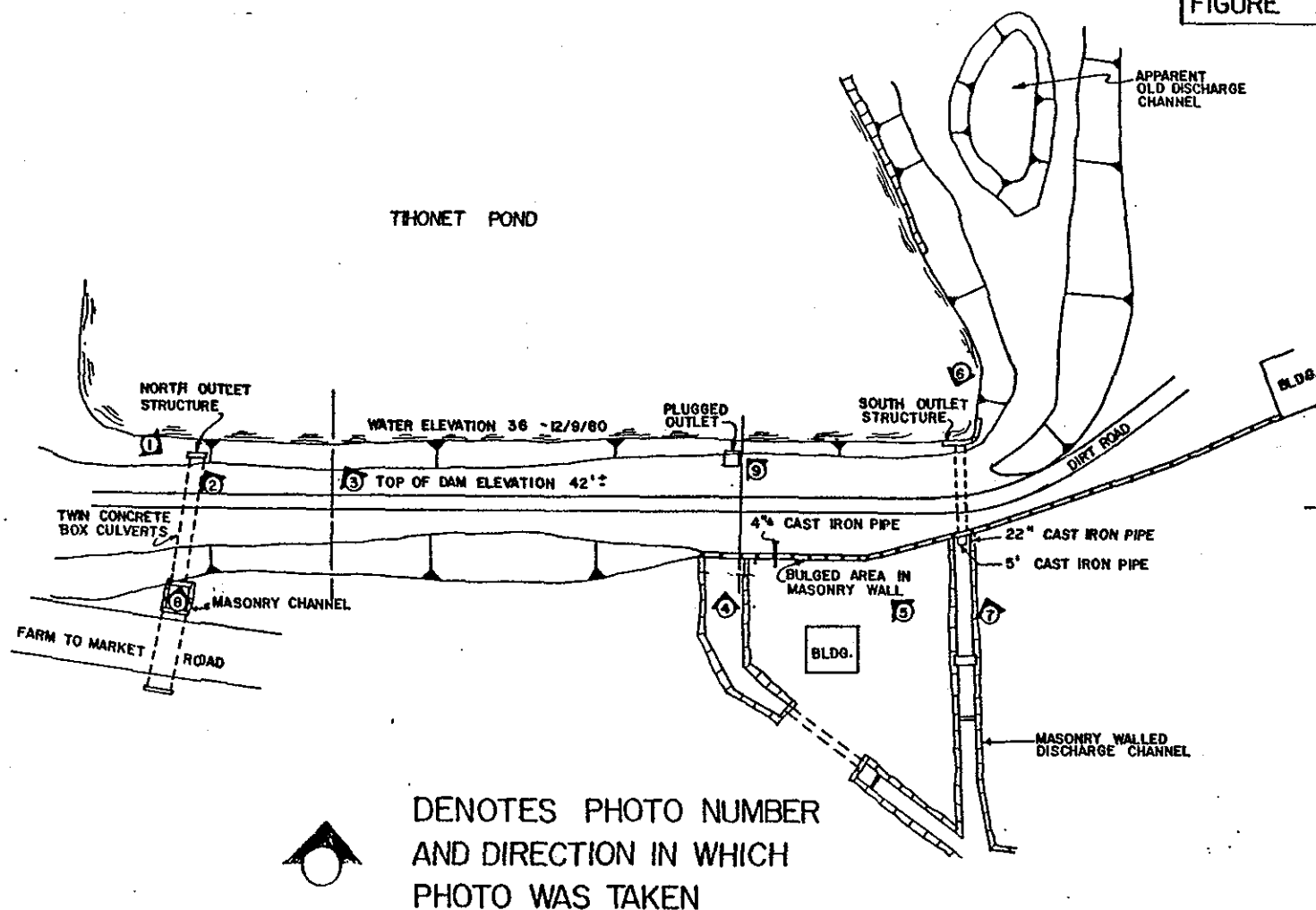
Sketch of Dam (not to Scale)





APPENDIX C  
PHOTOGRAPHS

FIGURE 3



DENOTES PHOTO NUMBER  
AND DIRECTION IN WHICH  
PHOTO WAS TAKEN

ASEC CORPORATION  
CONSULTING ENGINEERS  
BOSTON, MASS.

FEBRUARY 1981

## PHOTO LOCATION PLAN

TIHONET POND NO. 2 DAM

MA 00030

U.S. ARMY ENGINEER DIV. NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASS.



Photo # 1 Right Intake Structure and Upstream Dam Face



Photo # 2 Erosion near Right Intake Structure  
(Rule extended 6 feet)

U.S. ARMY ENGINEER DIV. NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS

ASEC CORP.  
CONSULTING ENGINEERS  
BOSTON, MASSACHUSETTS

NATIONAL PROGRAM  
OF INSPECTION OF  
NON-FED DAMS

TIHONET POND NO.2 DAM  
TR. TO WANKINCO RIVER  
WAREHAM, MASS.  
MA 00030  
DECEMBER 9, 1980





Photo # 3 Erosion at Upstream Dam Face  
(Rule extended 6 feet)



Photo # 4 Masonry wall and channel  
at Plugged Outlet

U.S. ARMY ENGINEER DIV. NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS

ASEC CORP.  
CONSULTING ENGINEERS  
BOSTON, MASSACHUSETTS

NATIONAL PROGRAM  
OF INSPECTION OF  
NON-FED. DAMS

TIHONET POND NO.2 DAM  
TR. TO WANKINCO RIVER  
WAREHAM, MASS.  
MA 00030  
DECEMBER 9, 1980





Photo # 5 Bulged wall at Downstream Face



Photo # 6 Left Outlet - Concrete Intake Structure

U.S. ARMY ENGINEER DIV. NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS

ASEC CORP.  
CONSULTING ENGINEERS  
BOSTON, MASSACHUSETTS

NATIONAL PROGRAM  
OF INSPECTION OF  
NON-FED. DAMS

TIHONET POND NO.2 DAM  
TR. TO WANKINCO RIVER  
WAREHAM, MASS.  
MA 00030  
DECEMBER 9, 1980





Photo # 7 Left Outlet - showing 5 ft. Iron Pipe, 22 inch Iron Pipe and Downstream Channel



Photo # 8 Right Outlet - Downstream face of 3.6 ft. high Twin Box Culverts

U.S. ARMY ENGINEER DIV. NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS

ASEC CORP.  
CONSULTING ENGINEERS  
BOSTON, MASSACHUSETTS

NATIONAL PROGRAM  
OF INSPECTION OF  
NON-FED. DAMS

TIHONET POND NO.2 DAM  
TR. TO WANKINCO RIVER  
WAREHAM, MASS.  
MA 00030  
DECEMBER 9, 1980





Photo # 9 Plugged intake of former outlet structure

U.S. ARMY ENGINEER DIV. NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM , MASSACHUSETTS

ASEC CORP.  
CONSULTING ENGINEERS  
BOSTON , MASSACHUSETTS

NATIONAL PROGRAM  
OF INSPECTION OF  
NON-FED. DAMS

TIHONET POND NO.2 DAM  
TR. TO WANKINCO RIVER  
WAREHAM, MASS.  
MA 00030  
DECEMBER 9, 1980





Photo # 10 Crest - Tihonet Pond #1 Dam



Photo # 11 Downstream Slope Tihonet Pond #1 Dam

U.S. ARMY ENGINEER DIV. NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS

ASEC CORP.  
CONSULTING ENGINEERS  
BOSTON, MASSACHUSETTS

NATIONAL PROGRAM  
OF INSPECTION OF  
NON-FED. DAMS

TIHONET POND NO.2 DAM  
TR. TO WANKINCO RIVER  
WAREHAM, MASS.  
MA 00030  
DECEMBER 9, 1980



APPENDIX D  
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

TIHONET POND NO. 2 DAM

WAREHAM, MA

---

Dam Rating Curve

A schematic sketch of the dam and outlet structures is shown in Figure 1. The sketch is based on a recent field inspection and survey of the site. This information was used in the hydrologic and hydraulic analysis of the dam.

North Outlet Spillway Discharge (left side)

$$Q_1 = CLH^{1.5}$$

C = 3.2 (sharp-crested weir)

L = 4.4'

H = head on weir crest (datem elev. 37.7 MSL)

$$Q_1 = 3.2 \times 4.4 \times H^{1.5}$$

North Outlet Spillway Discharge (right side)

$$Q_2 = CLH^{1.5}$$

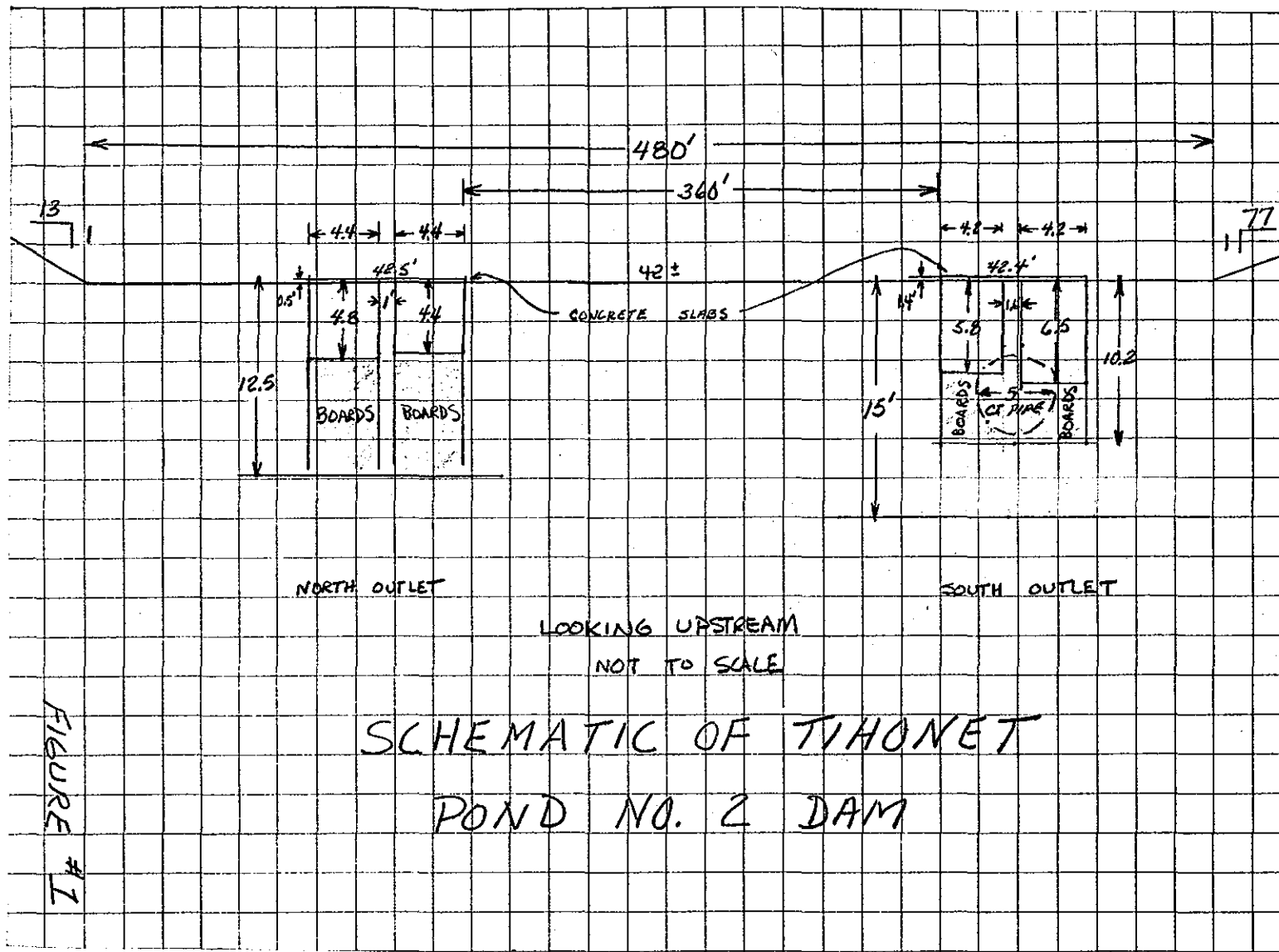
C = 3.2 (sharp-crested weir)

L = 4.4'

H = head on weir crest (datem elev. 38.1 MSL)

North Outlet Spillway Discharge (total)

$$\begin{array}{l} Q \text{ north} \\ \text{outlet} \\ \text{spillways} \end{array} = Q_1 + Q_2$$



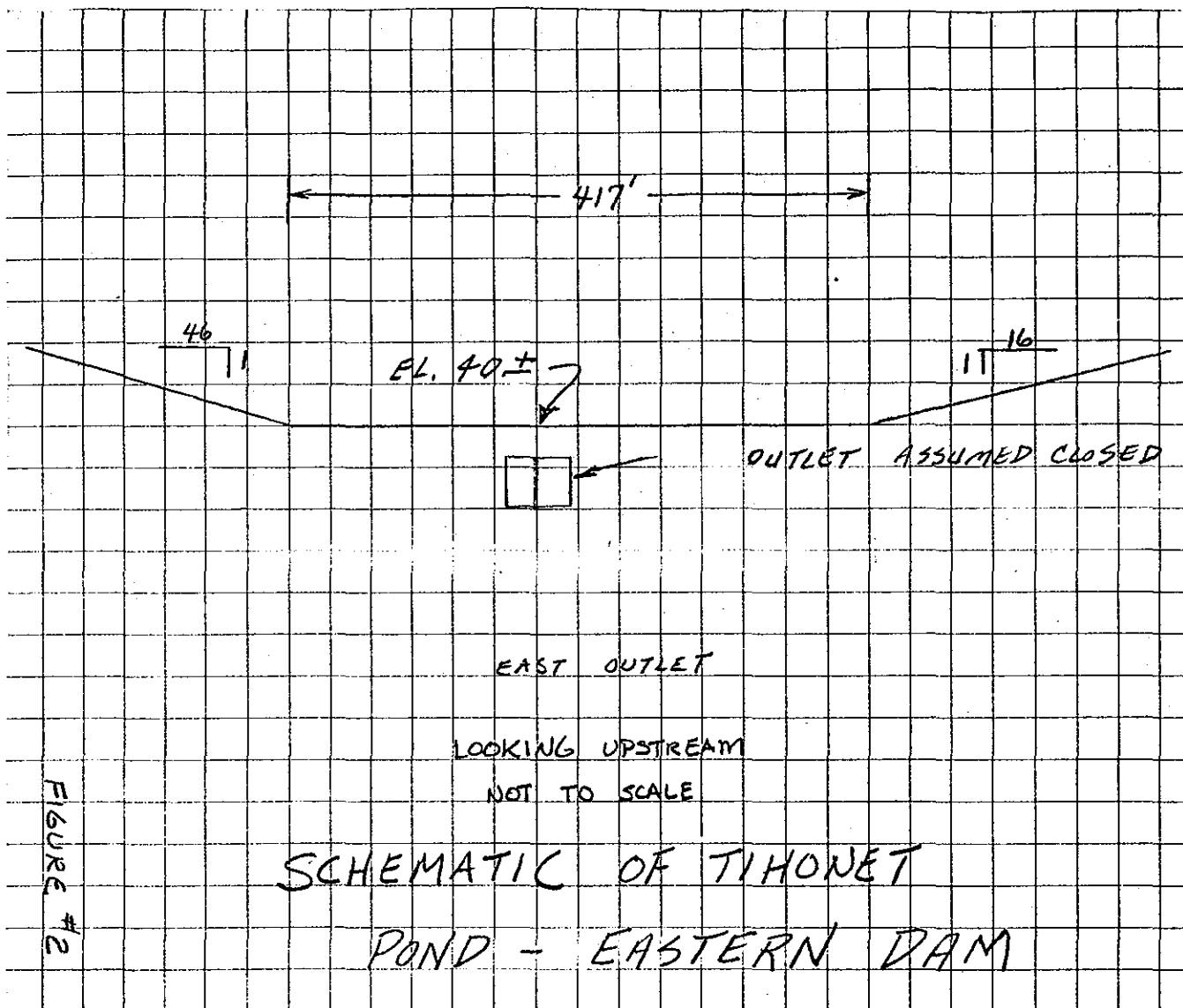


FIGURE #2

The north outlet structure also contains two box culverts -4.2 x 3.7 and -4.2 x 3.5 below the north spillways shown in Figure 1. The top of box for these culverts is at 31' MSL. The capacity of these culverts was checked using the Bureau of Public Roads Hydraulic Charts assuming inlet control and found to be sufficient to handle all discharges passing over the north outlet spillways. Therefore, only the north outlet spillways are shown on Figure 1.

South Outlet Spillway Discharge (left side)

$$Q_3 = CLH^{1.5}$$

$$C = 3.2 \text{ (sharp-crested weir)}$$

$$L = 4.2$$

$$H = \text{head on weir crest (datum elev. 36.6 MSL)}$$

$$Q_3 = 3.2 \times 4.2 \times H^{1.5}$$

South Outlet Spillway Discharge (right side)

$$Q_4 = CLH^{1.5}$$

$$C = 3.2 \text{ (sharp-crested weir)}$$

$$L = 4.2$$

$$H = \text{head on weir crest (datum elev. 35.9 MSL)}$$

$$Q_4 = 3.2 \times 4.2 \times H^{1.5}$$

South Outlet Spillway Discharge (total)

$$Q_{\text{south outlet spillways}} = Q_3 + Q_4$$

Below the south outlet spillways is a 5' diameter cast iron pipe. The capacity of this pipe was checked using the Bureau of Public Roads Hydraulic Charts assuming a concrete pipe of comparable roughness coefficient and assuming inlet control. It was found that the 5' CI pipe would cause the spillways to be submerged and therefore would control the outflow through the south outlet. The effects of the submerged weir were assumed to be negligible and a composite stage-discharge curve was constructed for the south outlet (see Graph 2).

In addition to the north and south outlets, there is also an outlet on the southeast side of Tihonet Pond on Tihonet Road (Figure 2). This outlet was assumed to be closed but flow over the roadway is computed using the standard weir flow equations.

#### Dam Embankment Overflow Discharge - East Outlet

$$Q_5 = CLH^{1.5}$$

$$C = 2.6 \text{ (broad-crested weir)}$$

$$L = 417'$$

$$H = \text{head on weir crest (datum elev. 40' MSL)}$$

$$Q_5 = 2.6 \times 417 \times H^{1.5}$$

#### Dam Embankment Side-Slope Discharge - Left

$$Q_6 = CLH^{1.5}$$

$$C = 2.6 \text{ (broad-crested weir)}$$

$$L = 46 \times H$$

$$h = 0.5 \times H$$

$$Q_6 = 2.6 \times (46 \times H) \times (0.5 \times H)^{1.5}$$

Dam Embankment Side-Slope Discharge - Right

$$Q_7 = CLH^{1.5}$$

$$C = 2.6 \text{ (broad-crested weir)}$$

$$L = 16 \times H$$

$$h = 0.5 \times H$$

$$Q_7 = 2.6 \times (16 \times H) \times (0.5 \times H)^{1.5}$$

Total Dam Discharge

$$Q_{\text{Total}} = Q_{\substack{\text{North} \\ \text{Outlet} \\ \text{Spillways}}} + Q_{\substack{\text{South} \\ \text{Outlet} \\ \text{Composite}}} + Q_5 + Q_6 + Q_7$$

The above relationship is plotted as the stage discharge curve for Tihonet Pond No. 2 (Graph 1).

## DAM FAILURE ANALYSIS

### Dam Failure with Maximum Pool

Assume that the dam fails with the pool at maximum level, which corresponds to the elevation of the top of the embankment (42.0 FEET MSL). The enclosed south outlet control structure includes two small flashboard dams followed by a 5' diameter cast iron pipe. The top of the embankment is 5.4' above the left spillway crest and 6.1' above the right spillway crest (looking downstream). The embankment is also 9.2' above the invert at the pipe entrance and 15.0' above the downstream invert (below the pipe).

### Normal Outflow at Failure

$$Q = 234 \text{ CFS (dam rating with } H = 9.2') *$$

\*NOTE: Assume that only south outlet contributes to downstream flows because north outlet and east outlet have their own channels and follow different flow paths.

### Tailwater Level at Failure

Cross-sections located throughout the downstream impact area were coded and input into a HEC-2 multiple profile run using nine discharges covering the range of discharges expected during dam failure analysis. Results were used to construct stage-discharge and stage-cross-section area curves for each cross section (see Graphs 2- 7).



The following are locations of cross-sections used in the dam failure analysis:

<u>Distance D/S of Dam (FT)</u>	<u>Normal Water Level (FT MSL)</u>
105	16.0
422	15.0
615	14.2
1675	14.0
2629	14.0

Immediately preceding failure, the normal outflow of 234 CFS results in a depth of 3.0 FEET (Graph 3) at the section located 105' downstream of the spillway.

#### Breach Outflow

$$Q_{p1} = 8/27 \times W_b \times \sqrt{g} \times Y_o^{1.5}$$

where:  $W_b$  = width of breach  
 $\leq 0.4 \times (\text{width of dam at } \frac{1}{2} \text{ height})$   
 $\leq 0.4 \times 480'$

use:  $W_b = 192'$

$Y_o$  = pool elevation - downstream invert = 15.0'

$$Q_{p1} = 8/27 \times 192 \times \sqrt{g} \times 15.0^{1.5} = 18,754 \text{ CFS}$$

### Total Outflow

$$Q_{\text{total}} = 234 + 18,754 = 18,988 \text{ CFS}$$

The table below gives pre-failure, downstream stages resulting from entering each section's stage-discharge curve at a discharge of 234 CFS (normal outflow at failure).

<u>Section (FT D/S of dam)</u>	<u>Pre-Failure Stage (FT MSL)</u>
105	17.5
422	16.4
615	14.5
1675	14.5
2629	14.5

### Impounding Capacities of Reservoir

Pool at top of dam (maximum - 42.0' MSL)

Volume = 1235 ACRE-FT

Pool at normal storage capacity (COE inventory)

Volume = 540 ACRE-FT

## Downstream Flooding

At 105' downstream of dam

Prior to failure

depth = 3.0' (Graph 3, with Q = 234 CFS)

After failure

depth = 20.8' (Graph 3, with Q = 18,988 CFS)

## Reach from 105' downstream to 422' downstream of dam

To estimate peak dam break flow at a distance 422' feet downstream of dam, we followed (essentially) the COE "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs."

Use stage-discharge and stage-cross-section area curves for sections 105' and 422' downstream of dam (Graphs 3 and 4).

### Storage volume in reach-versus-outflow

Assume channel and overbank storage of the flood wave is equal to the reach length times the average of the upstream post-failure flow area minus the upstream pre-failure flow area and the downstream post-failure flow area minus the downstream pre-failure flow area:

$$\text{Volume (Ft}^3\text{)} = \left[ \frac{(\text{Ap}_1 - \text{A}_{\text{N}_1}) + (\text{Ap}_2 - \text{A}_{\text{N}_2})}{2} \right] \times L$$

where :  $\text{Ap}_1$  = post-failure u/s cross-sectional flow area ( $\text{Ft}^2$ )

$\text{A}_{\text{N}_1}$  = pre-failure u/s cross-sectional flow area ( $\text{Ft}^2$ )

$\text{Ap}_2$  = post-failure d/s cross-sectional flow area ( $\text{Ft}^2$ )

$\text{A}_{\text{N}_2}$  = pre-failure d/s cross-sectional flow area ( $\text{Ft}^2$ )

L = reach length in feet

The attenuation of dam failure flow due to storage in the reach between 105' and 422' d/s:

$$Q_2 = 234 + Q_{p_1} \left( 1 - \frac{V_1}{S} \right) = 234 + 18,754 \left( 1 - \frac{V_1}{1235} \right)$$

where:  $V_1$  = volume of storage in reach, above pre-failure stage (acre-feet)

$S$  = storage in reservoir before failure (acre-feet)

$Q_{p_1}$  = breach outflow at upstream end of reach

$Q_2$  = total outflow at downstream end of reach after dam failure

The attenuation of peak dam failure flow at the downstream end of this reach is calculated on Graph 4. It can be seen from Graph 4 that the attenuation in the first reach has a negligible effect on discharge at the downstream end of the reach (section 2207). The attenuated peak failure flow at 422' d/s of the dam is 18,270 CFS with a corresponding stage of 29.0'. This post-failure stage is 12.6' above pre-failure stage and 14.0' above normal stream level.

There are three mill buildings located in the first reach (approximately 105' to 422' d/s). Their elevations range 4'-12' above stream level and these buildings would receive major damage. If occupied at the time of failure, there is also a significant danger of loss of life. Hammond Street runs just to the west of Tihonet Pond crossing the stream from the north outlet. The roadway embankment would be subject to overtopping by the flood wave along with probable washout just north of the intersection of Tihonet Road and Hammond Street. There is one house just south of the stream from the

north outlet on Hammond Street and this would suffer major damage. There is also a significant danger of loss of life at this location. Cranberry bogs in the vicinity would also suffer damage.

Between 422' and 615' d/s of the dam, the peak failure flow is attenuated to 17,984 CFS (Graph #5). The stage, however, drops from 29.0' MSL at 422' to 24.3' MSL at 615' d/s of the dam. At about 520' d/s of the dam, Tihonet Road crosses the stream from the south outlet with two 5' diameter corrugated metal pipes providing for the waterway. This is subject to overtopping and wash-out by the flood wave. At about 615' d/s of the dam, an access road enters to the pump station on Tihonet Road. This pump station would receive major flood damage. One house is also located on the east bank of the stream from the south outlet about 615' d/s of the dam. This house would not experience any flooding.

Between 615' and 1675' d/s of the dam, the floodplain widens out as the stream flows through Maple Swamp. The attenuation of the peak failure discharge in this reach is calculated on Graph 6. The effects of the storage in Maple Swamp are beginning to reduce the discharge from 17,984 at 615' to 15,073 at 1,675' d/s of the dam in this reach. Assuming a linear peak failure profile from 24.3' at the upstream end to 21.8' at the downstream end of this reach, the dam failure would cause some damage to (probable) three commercial/industrial buildings. There is also some danger of loss of life at this location.

The peak failure flow is attenuated to 11,266 CFS at 2,629 d/s of the dam by Maple Swamp with a corresponding stage of 20.5' MSL (Graph 7). There are no structures near the floodplain in this vicinity. State Route 25, however, does cross Maple Swamp about

2,835 d/s of the dam and would be subject to erosional damage caused by the flood wave impacting the roadway and passing through the waterway openings. It is doubtful that the flood wave would cause the failure of the Route 25 embankment.

Parker Mills Pond is located just downstream of Maple Swamp. The extensive storage of the pond will quickly attenuate peak failure discharges and corresponding stages to insignificant levels. However, if the surcharge storage of Parker Mills Pond is unavailable then the volume of the peak failure discharge may contribute to a failure of Parker Mills Pond Dam. For a more detailed discussion of Parker Mills Pond Dam, refer to the Phase I - COE Dam Inspection Report for Parker Mills Pond Dam.

## Test Flood Analysis

Size Classification: INTERMEDIATE (storage greater than 1000 and less than 50,000 acre-feet; height 40').

Hazard Classification: HIGH (based on significant danger of loss of life and significant economic loss at 3 mill buildings, 3 (probable) commercial/industrial buildings, 1 house, the Tihonet Road Pump Station, Hammond Street and Tihonet Road.

According to COE "Recommended Guidelines" the size and hazard classifications of the dam indicate a test flood equal to a PMF.

The COE PMF curves yield a discharge of 750 CFS/sq. mile for the flat and coastal region. This is a PMF of 6075 CFS for the 8.1 square mile drainage area.

### Stage Storage Curve

The storage at the lowest spillway crest (35.9' MSL) is approximately 540 acre-feet. The pond surface area at 35.9' MSL is approximately 94 acres as measured from the USGS quadrangle map. The pond surface area at 40' MSL, the east outlet roadway crest, is approximately 121 acres as measured from the USGS quadrangle map. The storage is computed as follows:

$$\text{Surcharge Storage} = \left[ \frac{94 + 121}{2} \times h \right] = 108 \times 4.1 \\ = 443 \text{ acre feet}$$

$$\text{Total Storage} = 540 + 443 = 983 \text{ acre feet.}$$

The stage storage curve is given on Graph #8.

For the drainage area of 8.1 square miles or 5,184 acres:

$$1" \text{ of runoff} = \frac{5,184 (1")}{12"/\text{foot}} = 432 \text{ acre-feet}$$

$$1 \text{ acre-foot} = 1/432 = 0.0023" \text{ of runoff}$$

Surcharge Storage to the roadway crest =

$$443 \text{ acre-feet} = 1.0" \text{ of runoff}$$

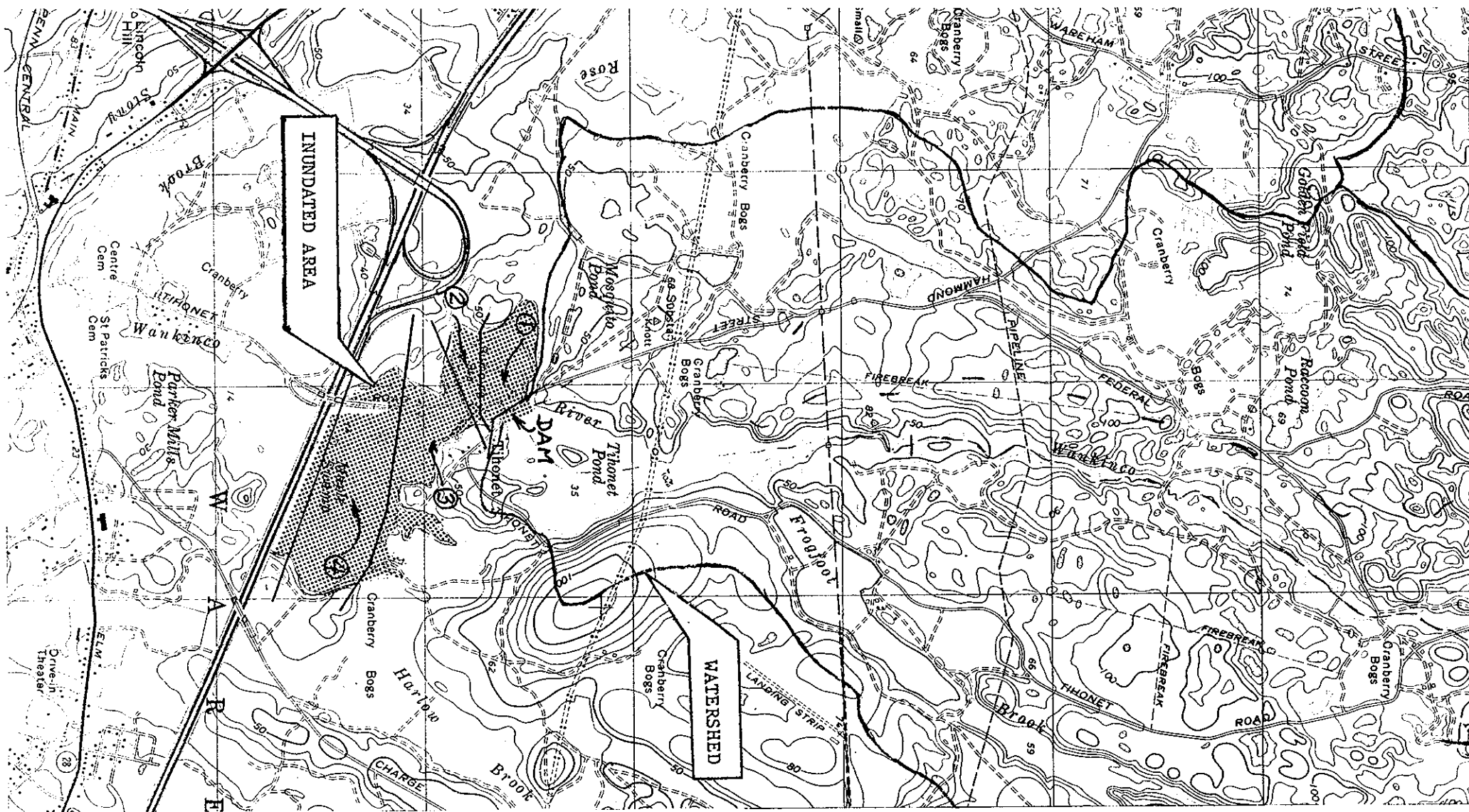
The attenuation of the test flood inflow due to surcharge storage in the pond is calculated on Graph 9.

The peak test flood outflow is 5500 CFS, with a corresponding stage of 42.45 MSL, which is 2.5' above the top of the roadway crest at the east outlet and 0.5' above the dam crest at the south outlet.



The table below summarizes the downstream effect of failure of Tihonet Pond Dam No. 2:

Location no. (see map)	Distance D/S of Dam (ft)	Number of Structures	Level Above Stream (ft)	Flow (CFS) Stage (Ft. above Stream)		Comments
				Before Failure	After Failure	
1	105 - 422	3 mill buildings	4-12	234/1.5	18,988/19.3	Major damage to mill buildings. Significant dan- ger of loss of life.
		road	4-5			Probable wash-out.
		1 house	4-5			Major damage to 1 house. Significant danger of loss of life.
2	422- 615 615	road	5	234/1.4	18,270/14	Probable wash-out.
		pump station	5-6			Major damage to pump sta.
		1 house	15-16			
3	615- 1,675'	3 (probable) commercial/ industrial bldgs.	5-10	234/0.3	17,984/10.2	Some damage to (probable) commercial/industrial buildings. Some danger of loss of life.
4	1,700			234/0.5	15,073/7.8	Flood wave attenuating in Maple Swamp.
	2,629			234/0.5	11,266/6.5	
	2,835	road	15-26			Some erosional damage as flood wave impacts roadway & passes through waterway openings.

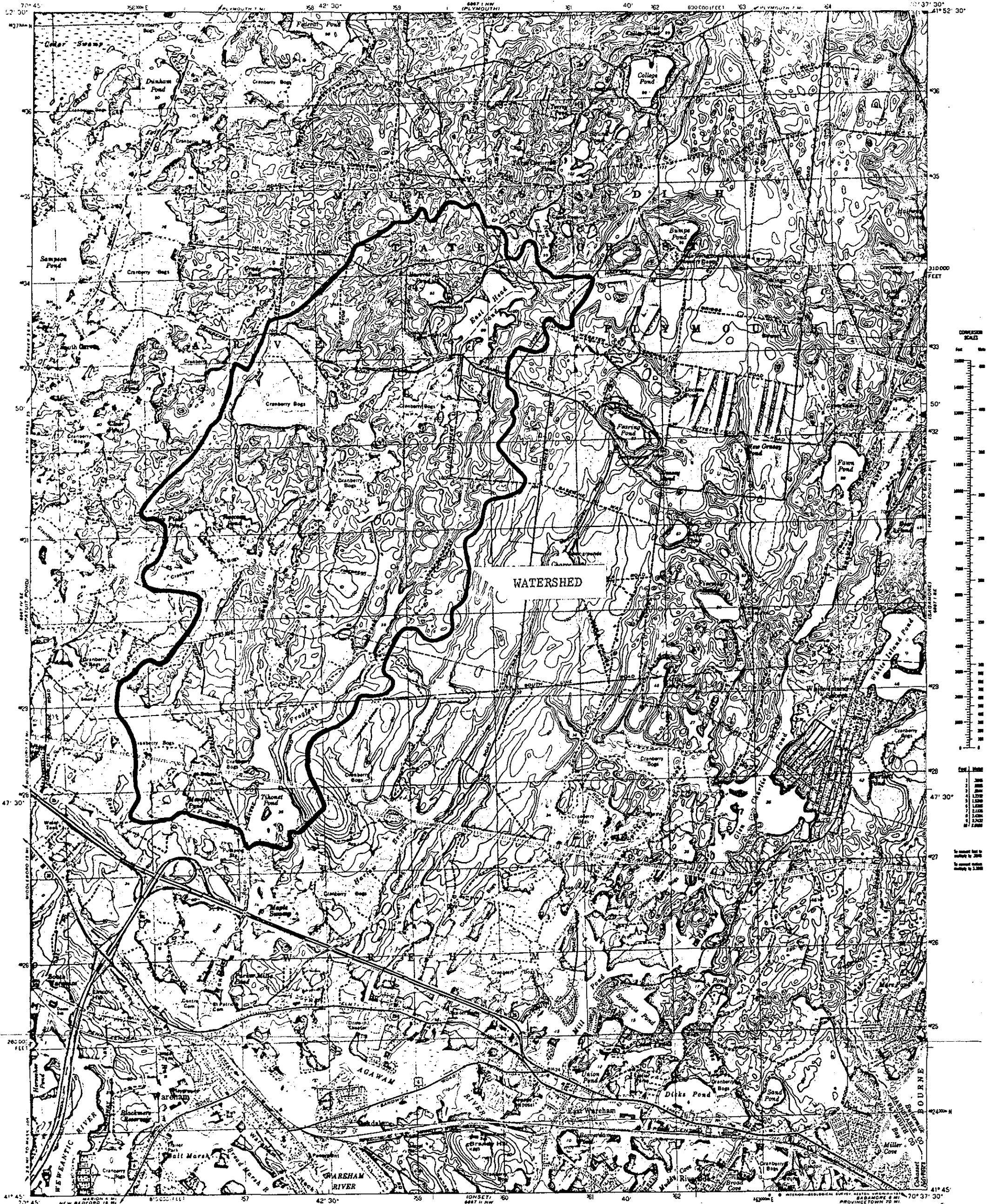


# WATERSHED PLAN/CROSS-SECTION LOCATIONS

TIHONET POND NO. 2 DAM

WAREHAM, MASSACHUSETTS

1" = 2,083.3'



Mapped, edited, and published by the Geological Survey  
Control by USGS, USC&GS, and Massachusetts Geodetic Survey  
Topography by planimetric surveys 1934-1935. Revised from  
aerial photographs taken 1971. Field checked 1972  
Selected hydrographic data compiled from USC&GS chart 251 (1970)  
This information is not intended for navigational purposes  
Polyconic projection 1927 North American datum  
10,000-foot grids based on Massachusetts coordinate system,  
mainland zone  
1000-meter Universal Transverse Mercator grid,  
zone 19

UTM GRID AND 1972 MAGNETIC NORTH  
DECLINATION AT CENTER OF SHEET

SCALE 1:25 000  
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100  
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000  
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100  
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000  
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100  
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET  
DATUM IS MEAN SEA LEVEL  
DEPTH CURVES AND SOUNDINGS IN FEET-DATUM IS MEAN LOW WATER  
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF BEACH HIGH WATER  
THE MEAN RANGE OF TIDE IS APPROXIMATELY 4.5 FEET

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS  
FOR SALE BY U.S. GEOLOGICAL SURVEY, RESTON, VIRGINIA 22092  
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST



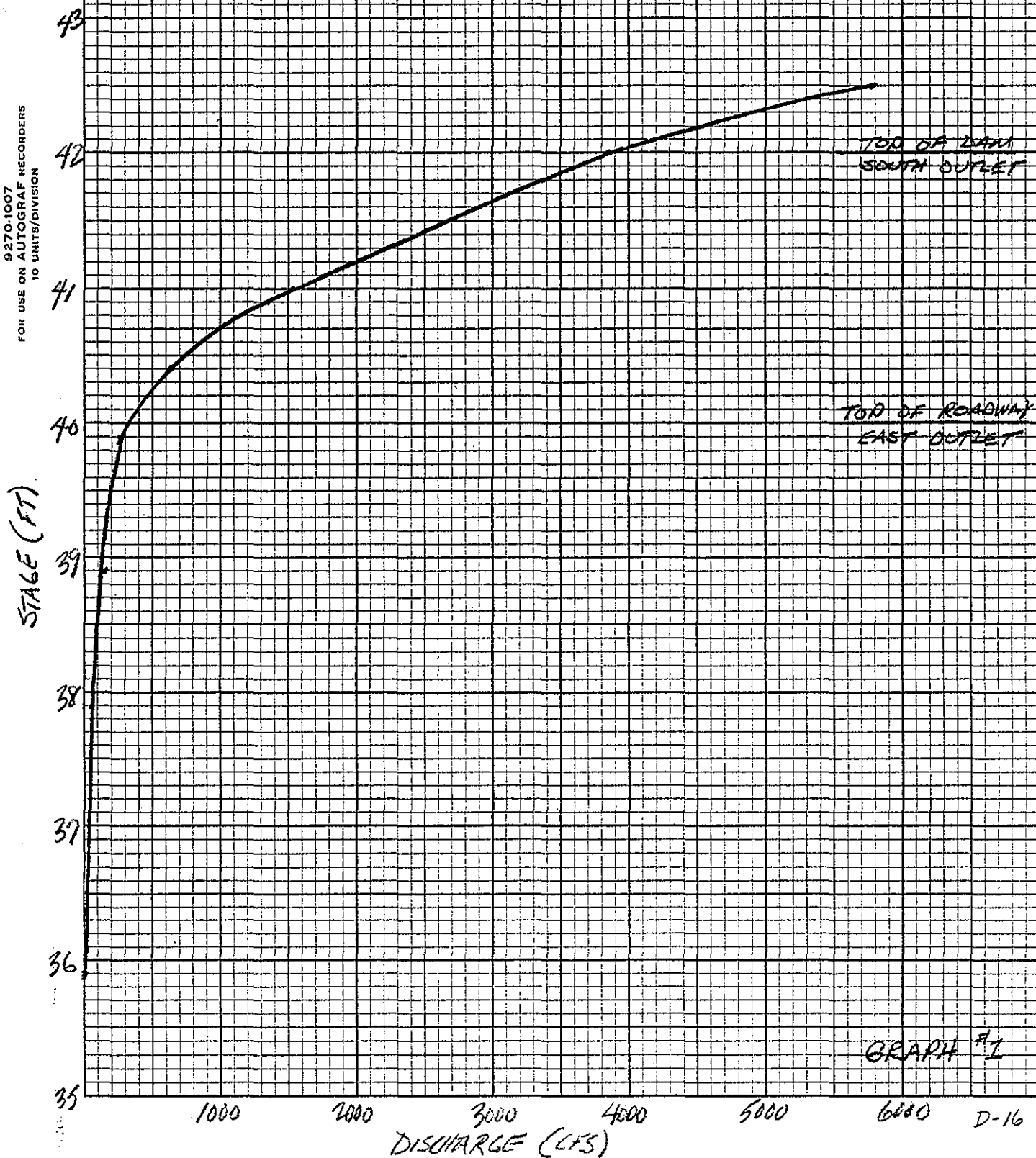
ROAD CLASSIFICATION  
Primary highway, hard surface  
Secondary highway, hard surface  
Light-duty road, hard or improved surface  
Unimproved road  
Interstate Route  
U.S. Route  
State Route

WAREHAM, MASS.  
N4145-W7037.5/7.5  
1972

AMS 6867 1 NW-SERIES 7014

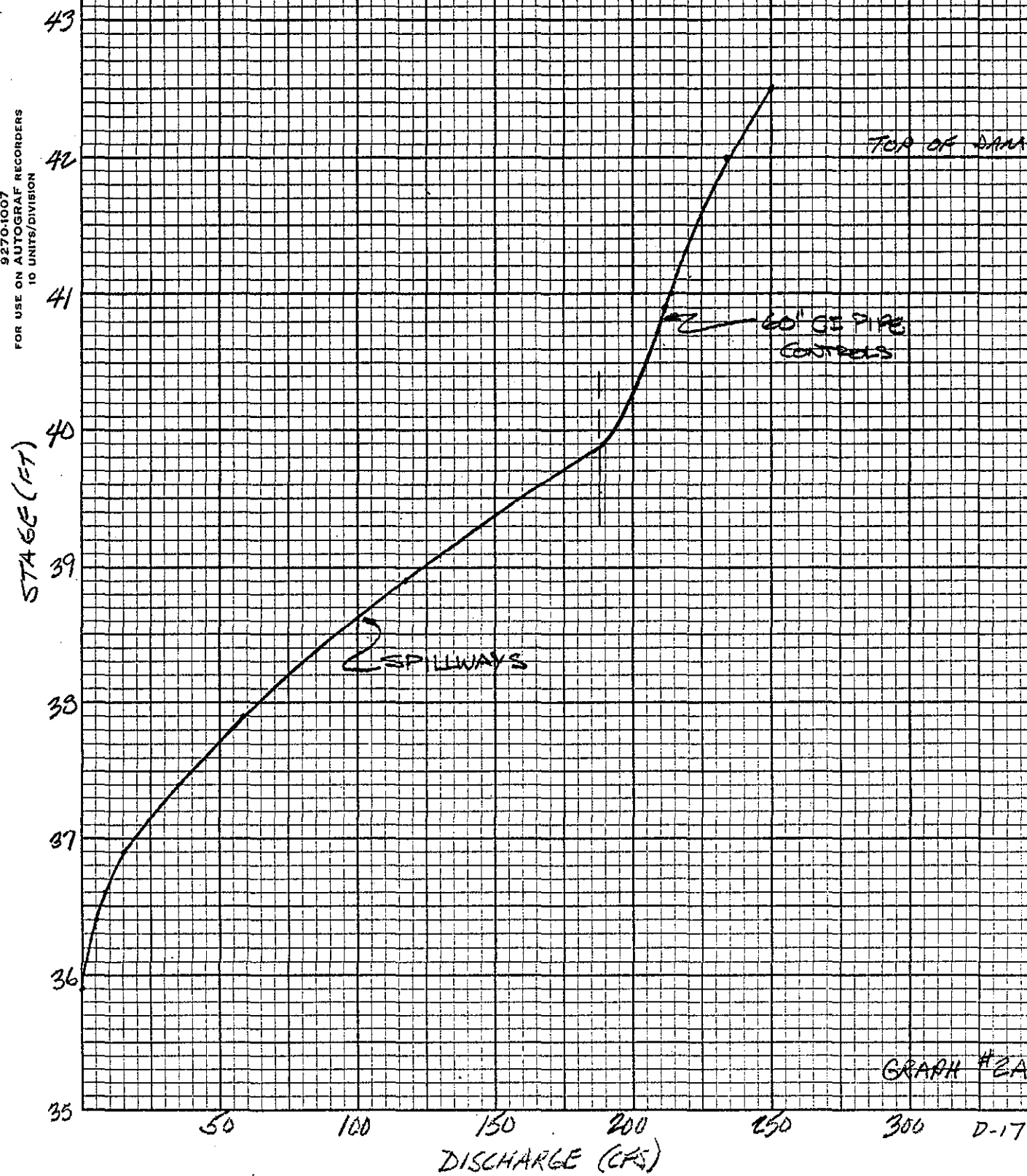
WATERSHED PLAN - TIHONET POND NO. 2 DAM

STAGE-DISCHARGE CURVE  
TIMONET POND No. 2  
NORTH, SOUTH & EAST OUTLETS



STAGE-DISCHARGE CURVE  
THROWJET POND NO. 2  
SOUTH OUTLET

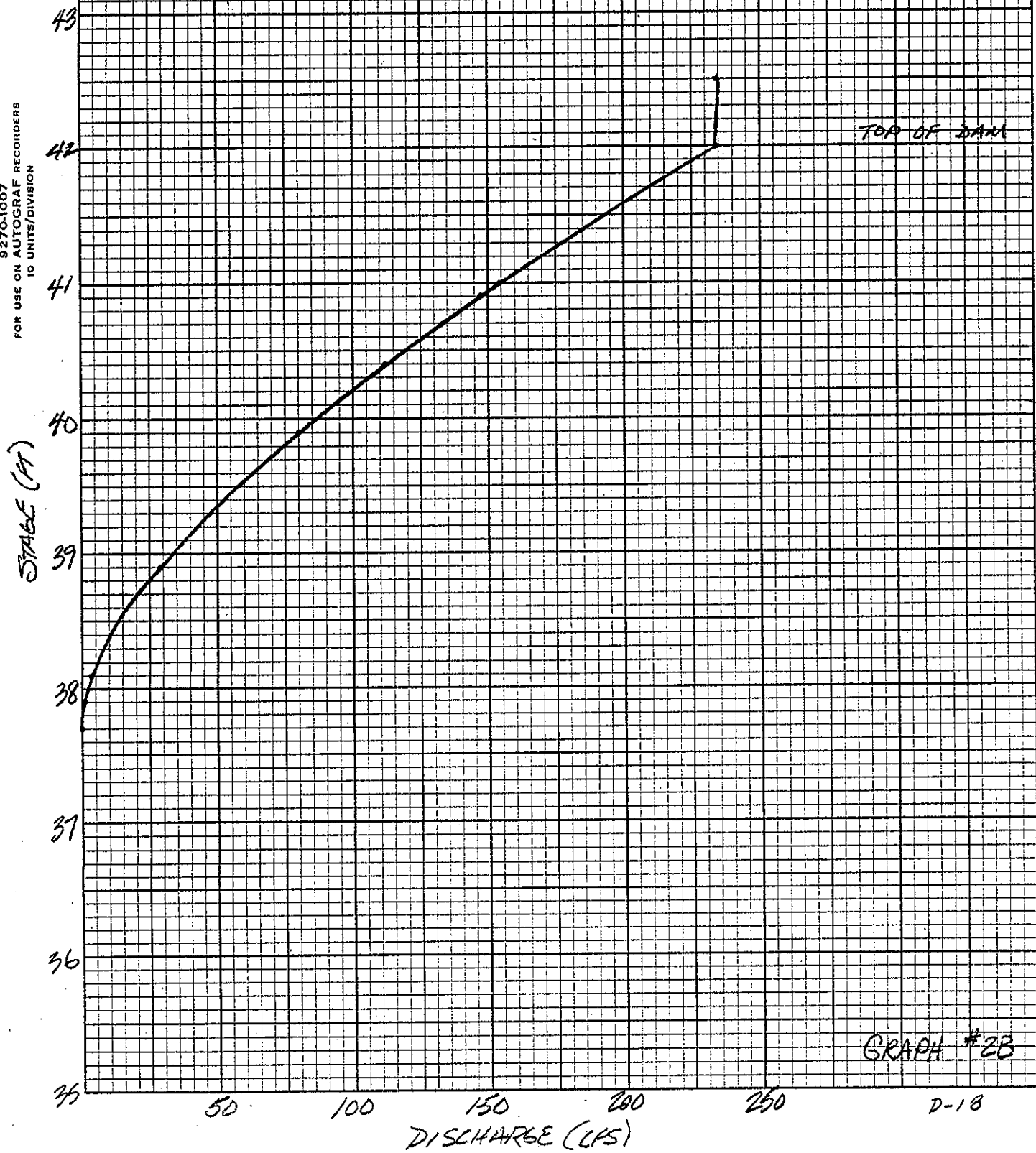
9270-1007  
FOR USE ON AUTOGRAPH RECORDERS  
10 UNITS/DIVISION



GRAPH #2A

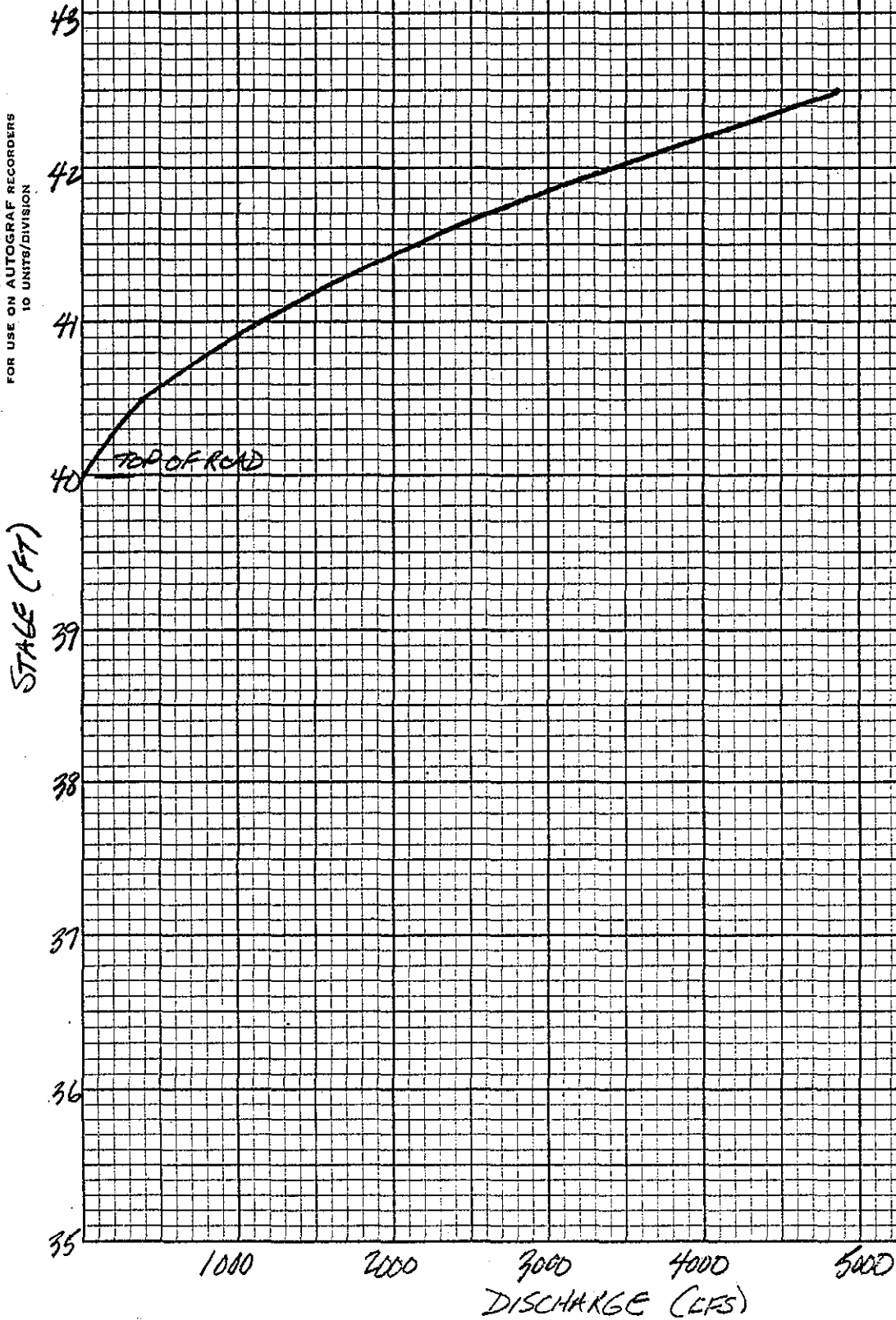


STAGE-DISCHARGE CURVE  
TINHOLET POND NO 2  
NORTH OULET

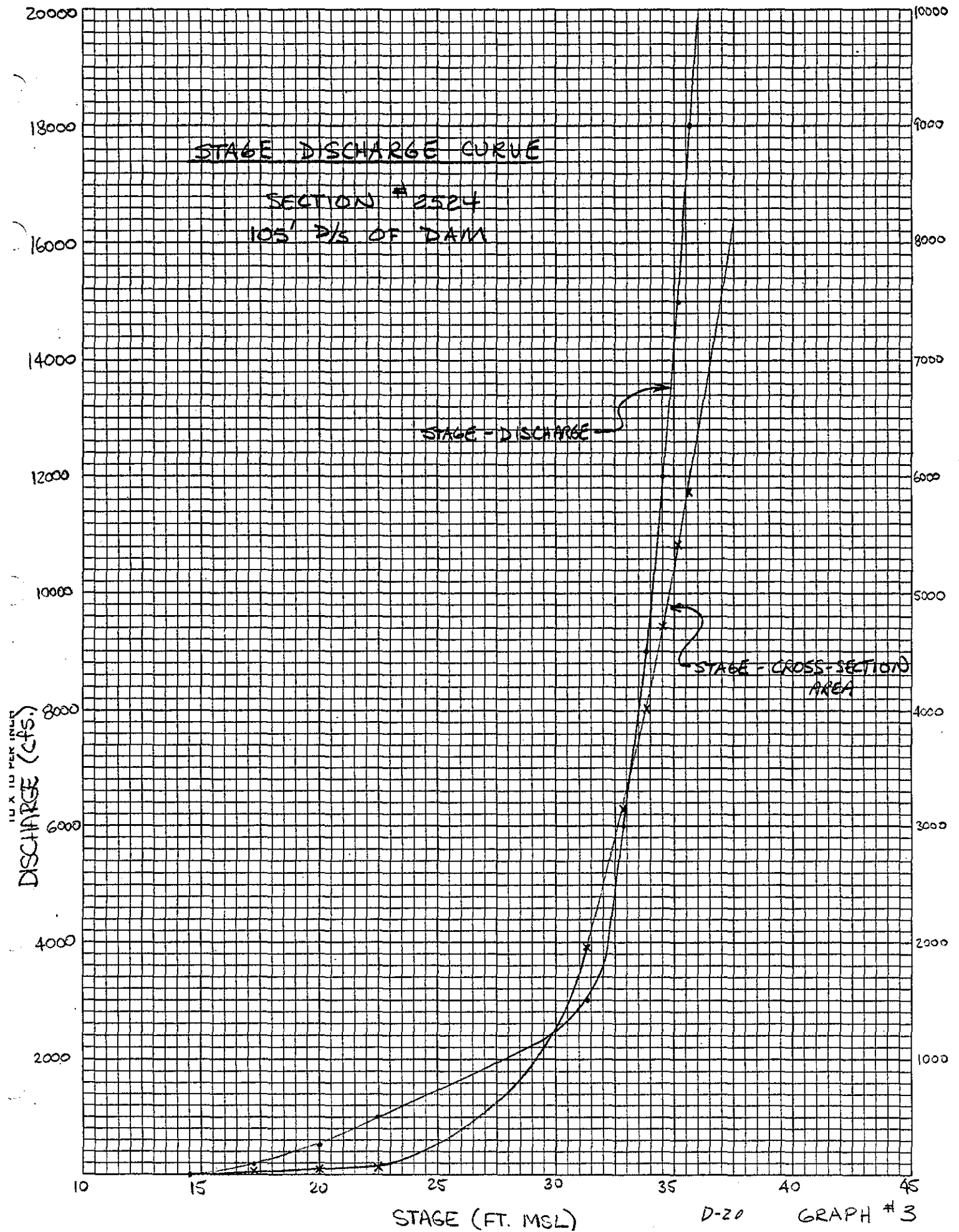


GRAPH #28

STAGE - DISCHARGE CURVE  
TIMHURST POND NO 2  
EAST OUTLET  
(ASSUMED CLOSED)



GRAPH #2C

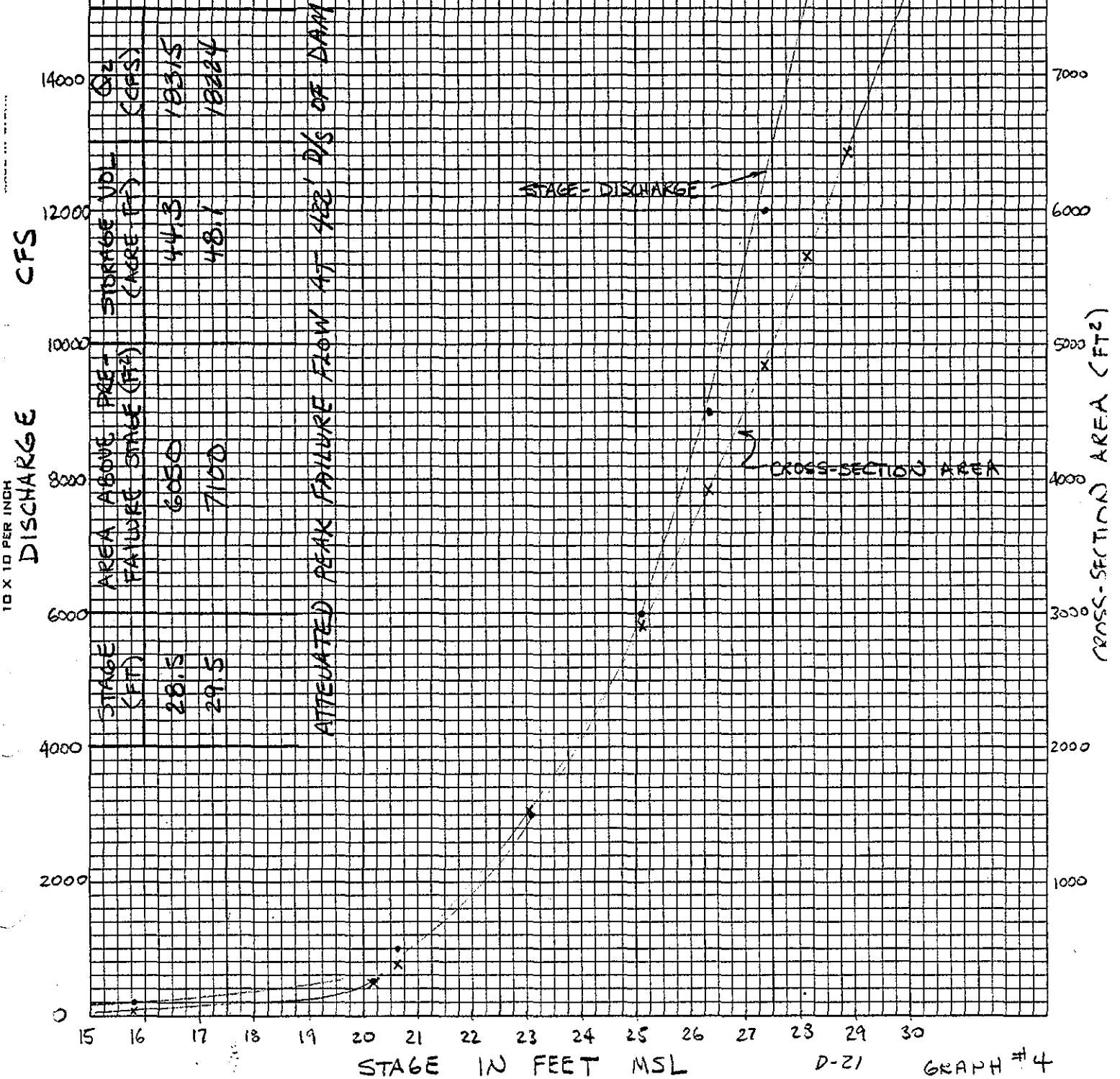




# STAGE - DISCHARGE CURVE

SECTION #2207  
422' D/S OF DAM

$Q_2 = 18,270 \text{ cfs}$   
STAGE = 29.0'



# STAGE-DISCHARGE CURVE

SECTION - #2014

615' - P/S OF DAM

$Q_2 = 17,984$

STAGE = 24.3'

DISCHARGE  
10 X 10 PER INCH  
CFS

STAGE (FT)	AREA ABOVE PRE- FAILURE STAGE (FT <sup>2</sup> )	STORAGE VOL (ACRE-FT)	$Q_2$ (CFS)
23.5	1800	18.4	18,001
25.0	2860	20.8	17,966

ATTENUATED PEAK FAILURE FLOW AT 615' P/S OF DAM

STAGE-DISCHARGE 2

CROSS-SECTION  
AREA

CROSS-SECTION AREA (FT<sup>2</sup>)

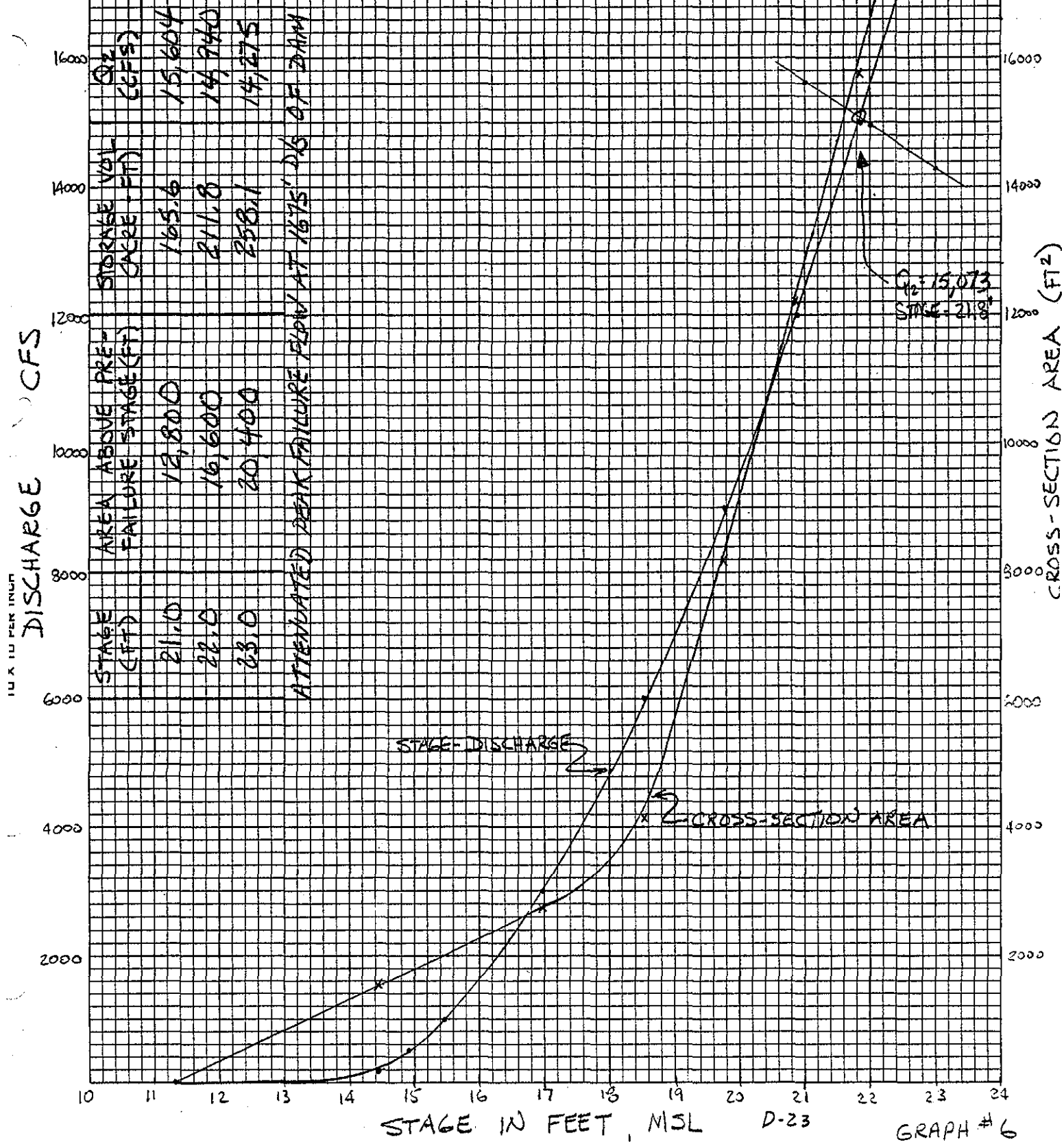
STAGE IN FEET, MSL

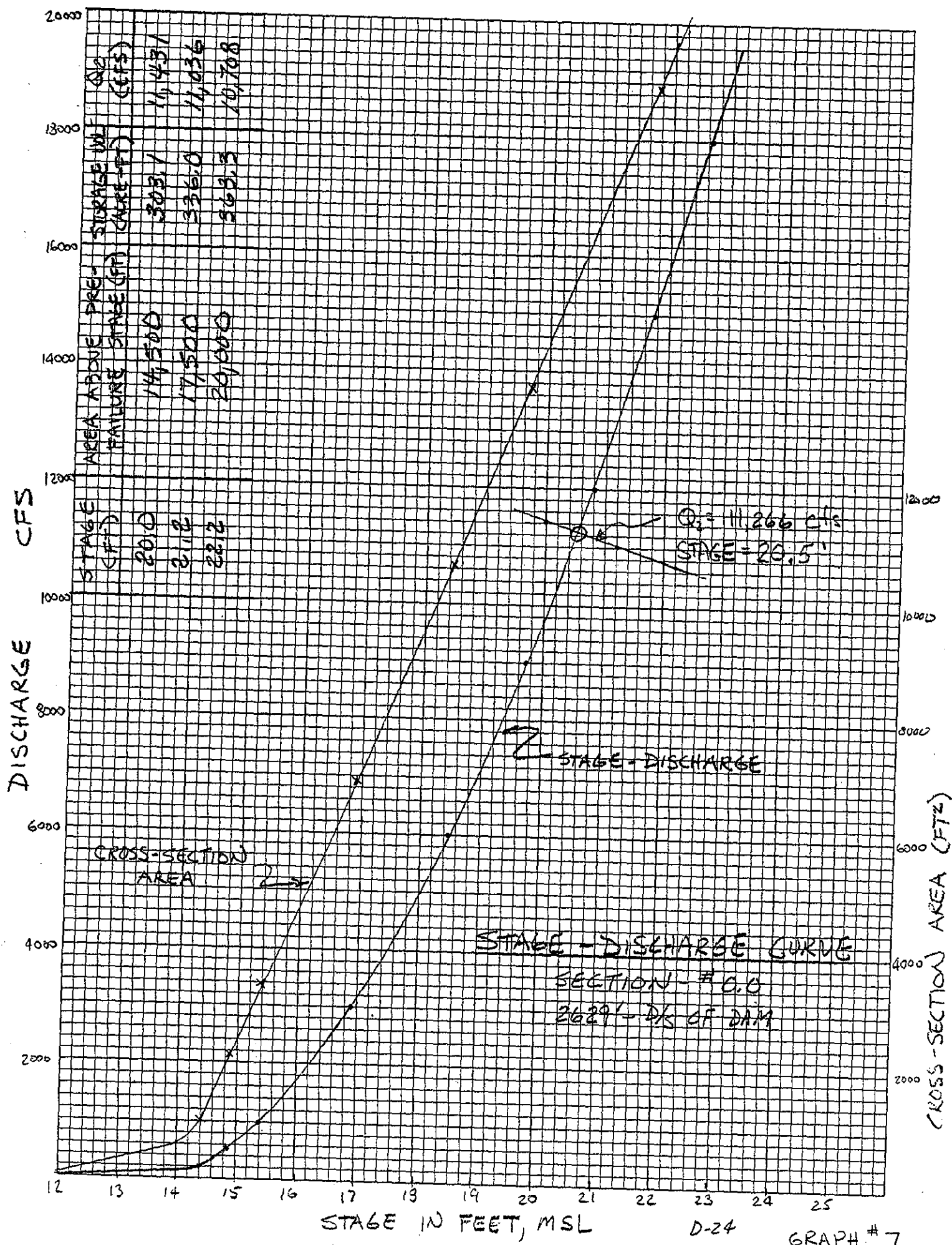
D-22

GRAPH #5

# STAGE-DISCHARGE CURVE

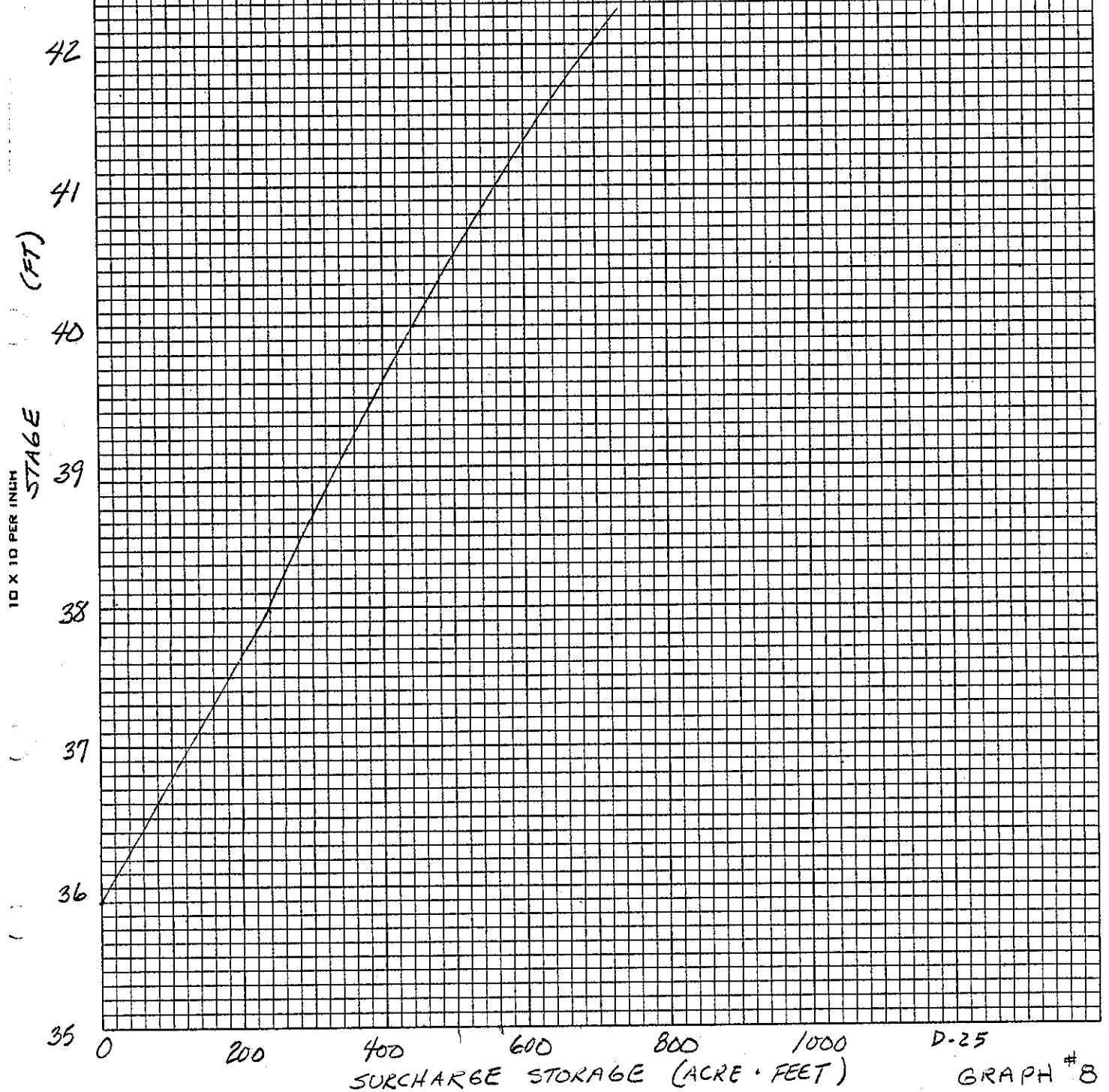
SECTION - #1954  
1675' - D/S OF DAM



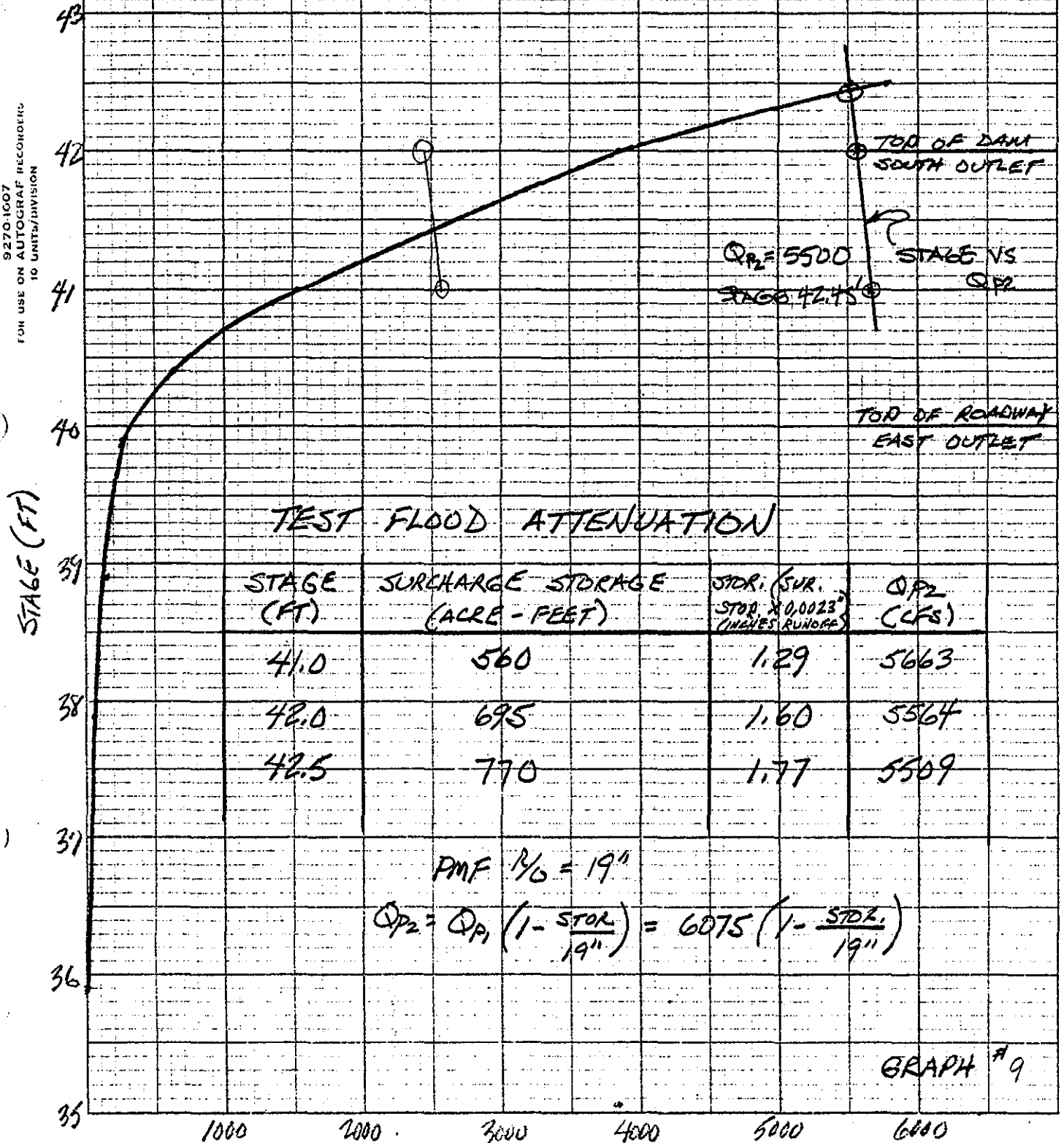


# STAGE SURCHARGE STORAGE CURVE

TIMONET POND NO. 2



STAGE-DISCHARGE CURVE  
TIKONET POND NO. 2  
NORTH, SOUTH & EAST OUTLETS



APPENDIX E  
INFORMATION AS CONTAINED IN  
THE NATIONAL INVENTORY OF DAMS